

**Fig 1A  
(PRIOR ART)**

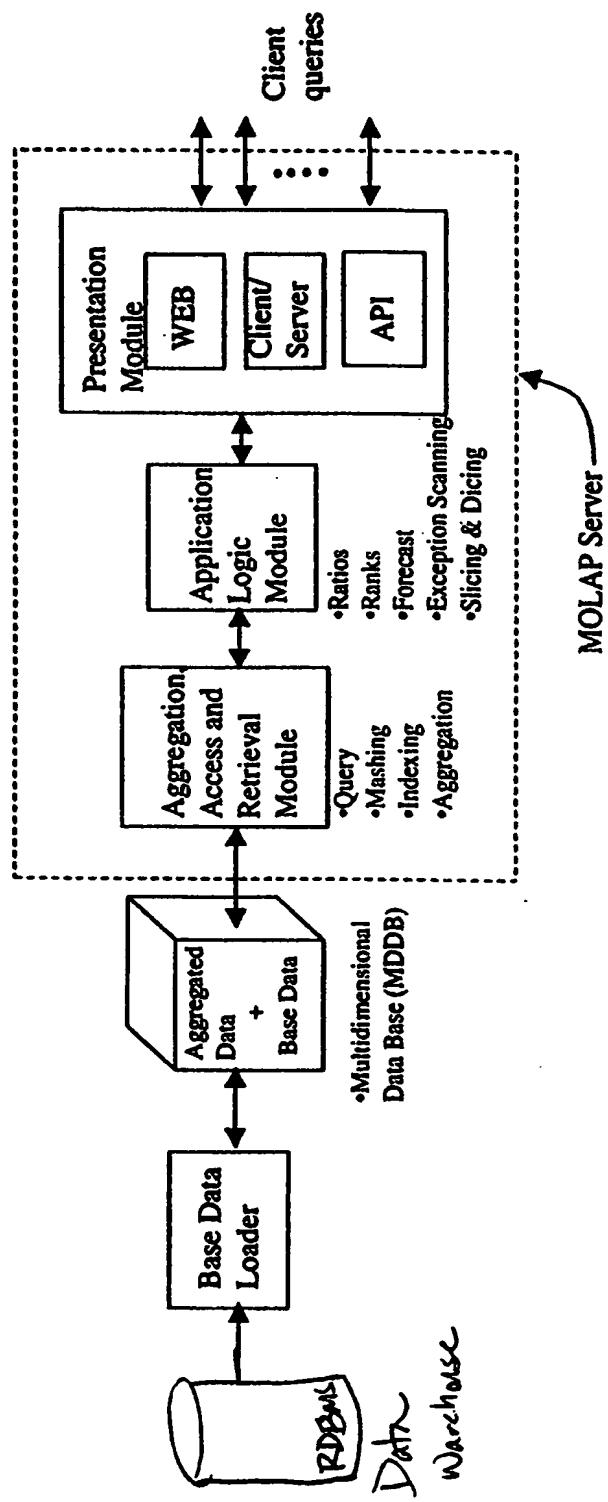
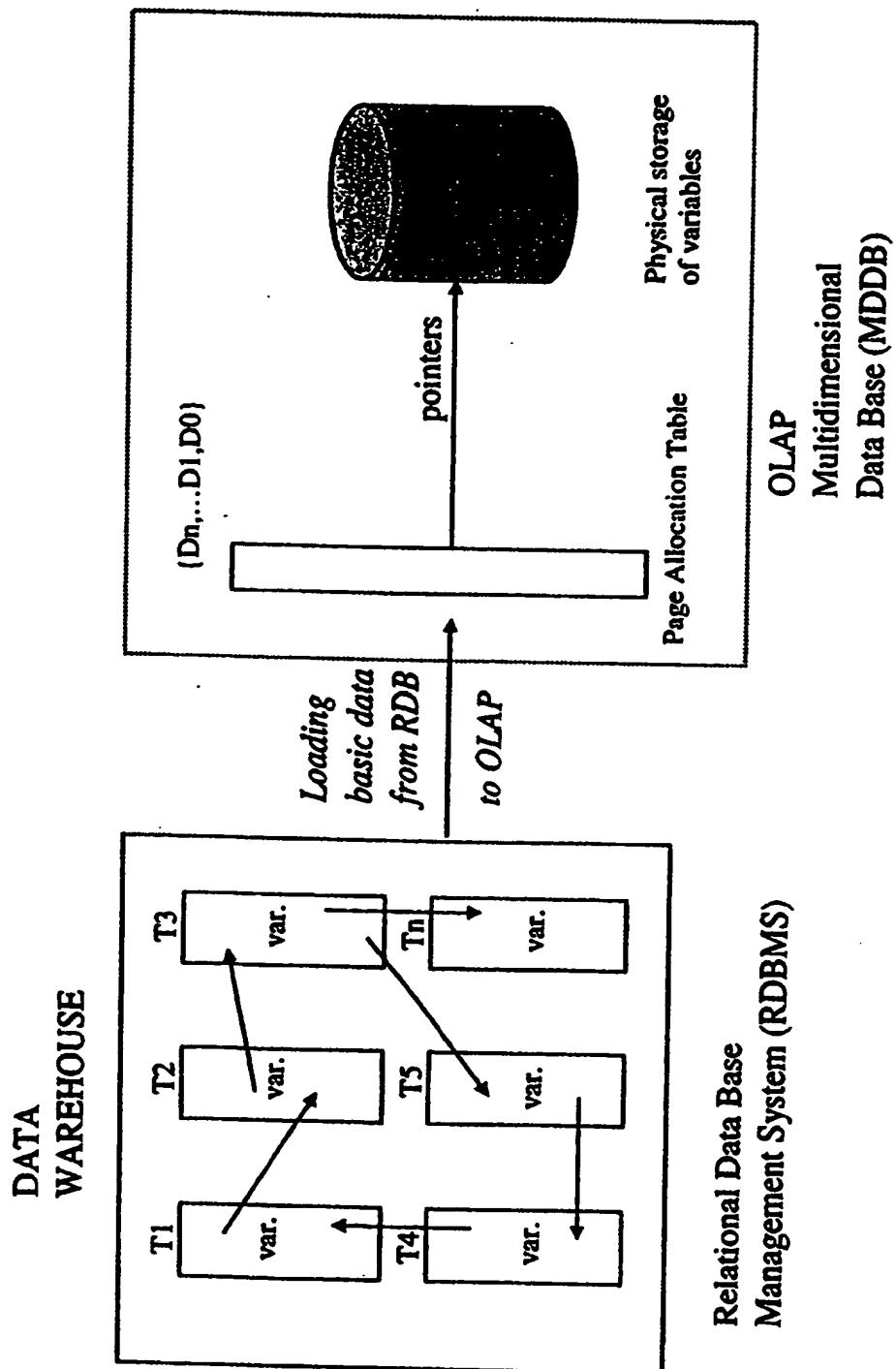
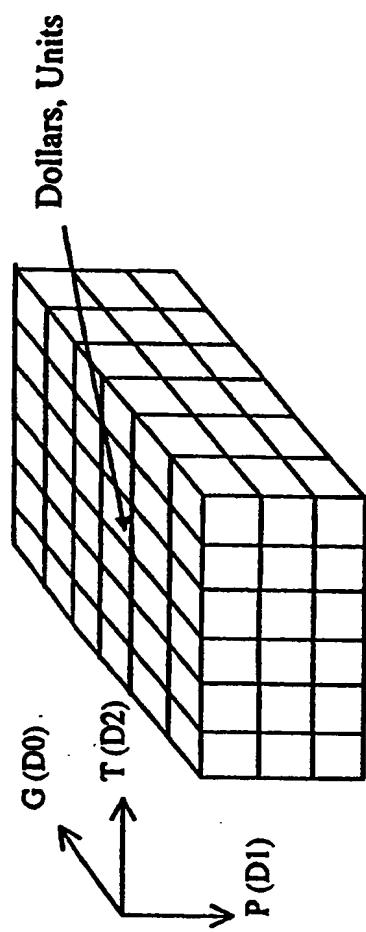


FIG. 1B



**Fig. 2A**  
**(PRIOR ART)**

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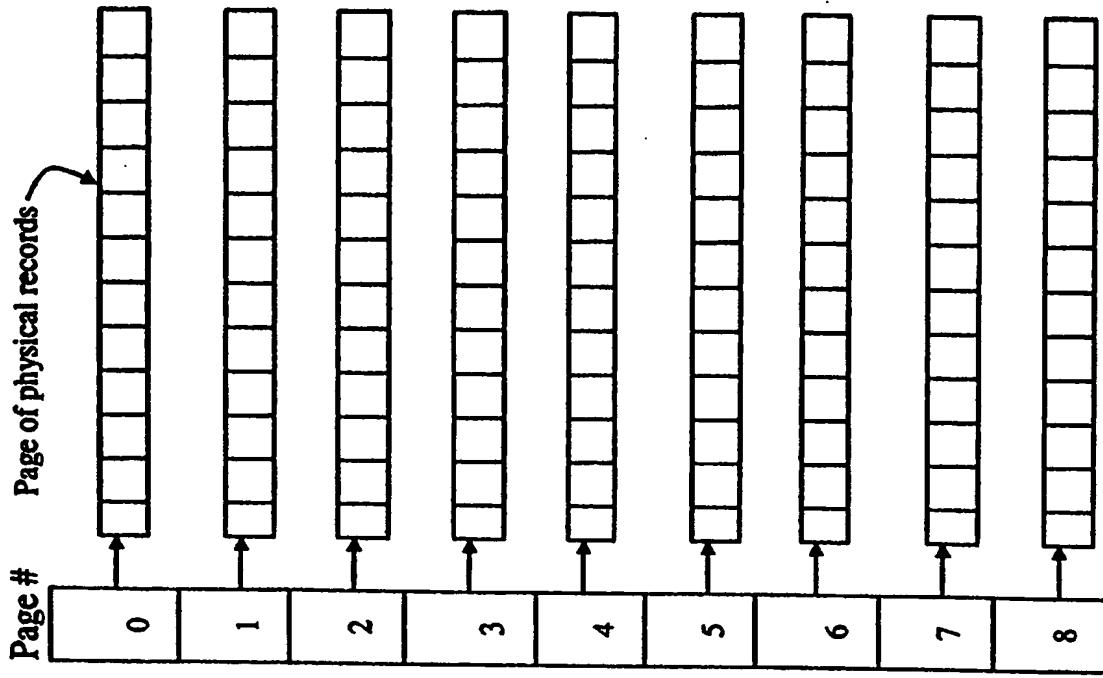
G geography (e.g. cities, states, countries, continents)  
T time (e.g., days, weeks, months, years)  
P products (e.g. all products, by manufacturer)

Fig. 2B  
(PRIOR ART)

**Page Allocation Table pointing on physical records of a multidimensional variable (e.g. the two first rows of a variable of FIG. 2B reside in page # 0)**

		D0	0	1	2	3	4	5
		D1=0	1	2	3	4	5	6
D2=0		D1=1	1	2	3	4	5	6
D1=0	D1=1	1	2	3	4	5	6	7
D1=1	D1=2	1	2	3	4	5	6	7
D1=2	D1=3	1	2	3	4	5	6	7
D1=3	D1=0	1	2	3	4	5	6	7
D1=0	D1=1	1	2	3	4	5	6	7
D1=1	D1=2	1	2	3	4	5	6	7
D1=2	D1=3	1	2	3	4	5	6	7
D1=3	D1=0	1	2	3	4	5	6	7

**Array structure of a multidimensional variable**



**Fig. 2C**

**Fig. 2D  
and A.Dm**

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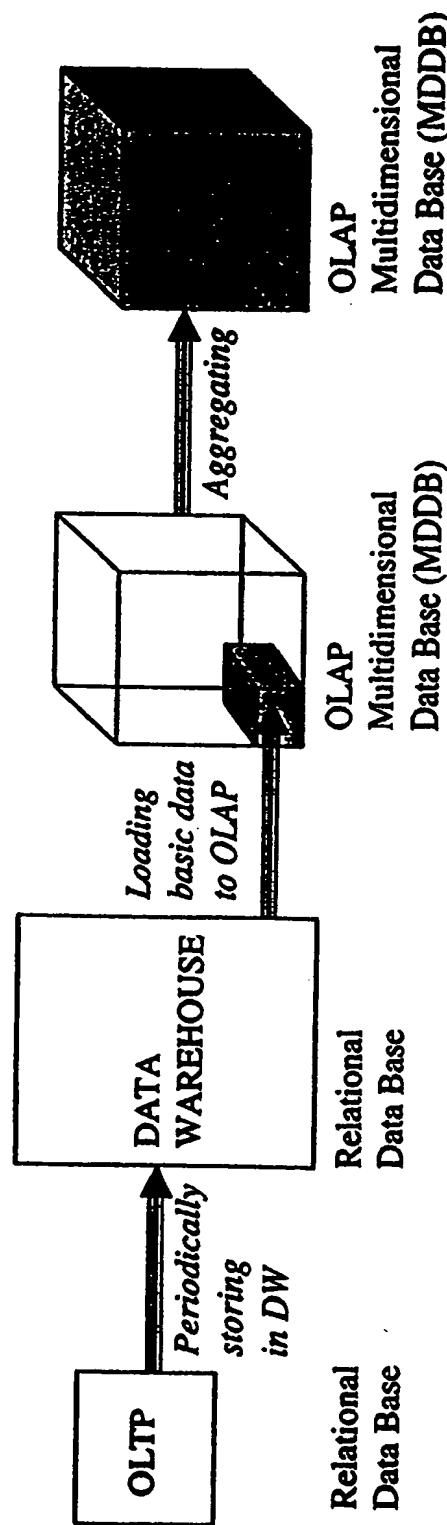


Fig. 3A  
(PRIOR ART)

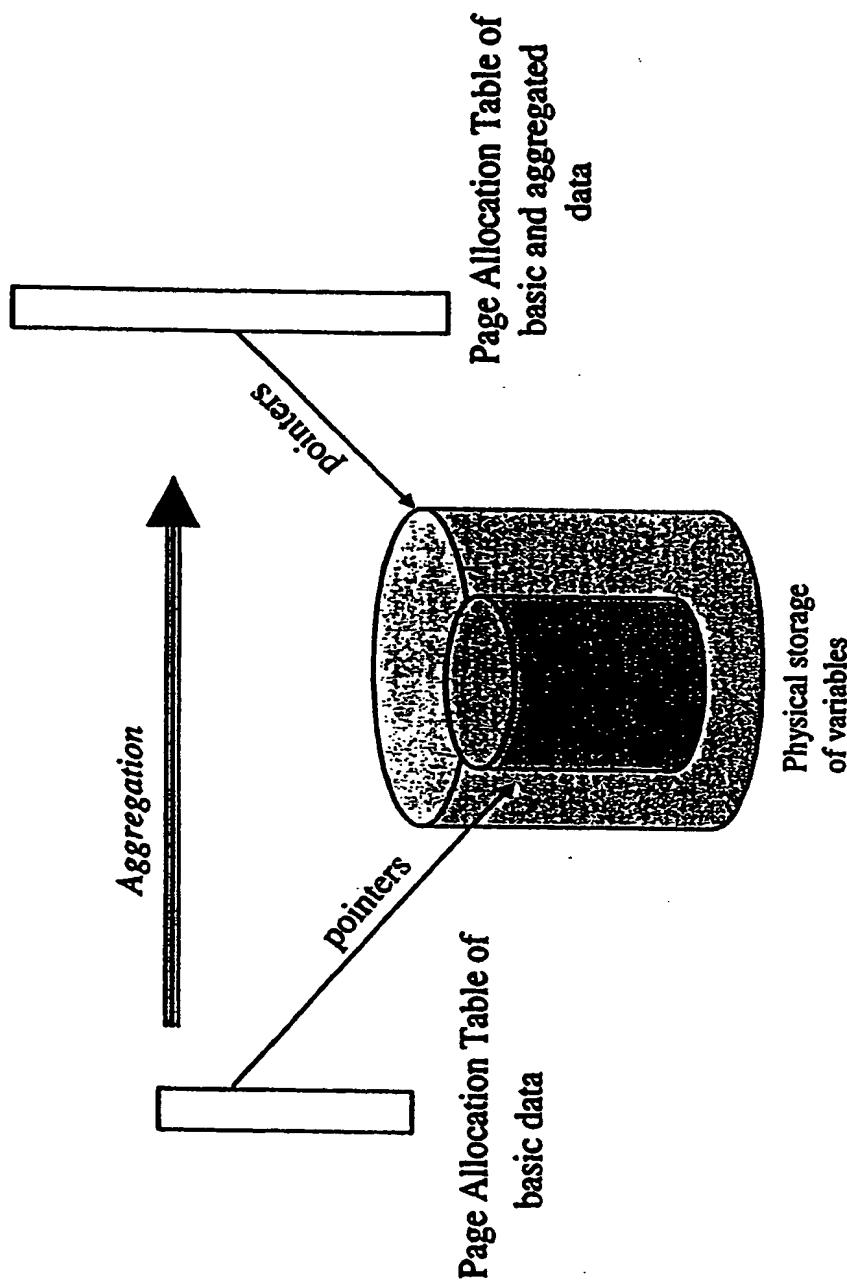


Fig. 3B  
(PRIOR ART)

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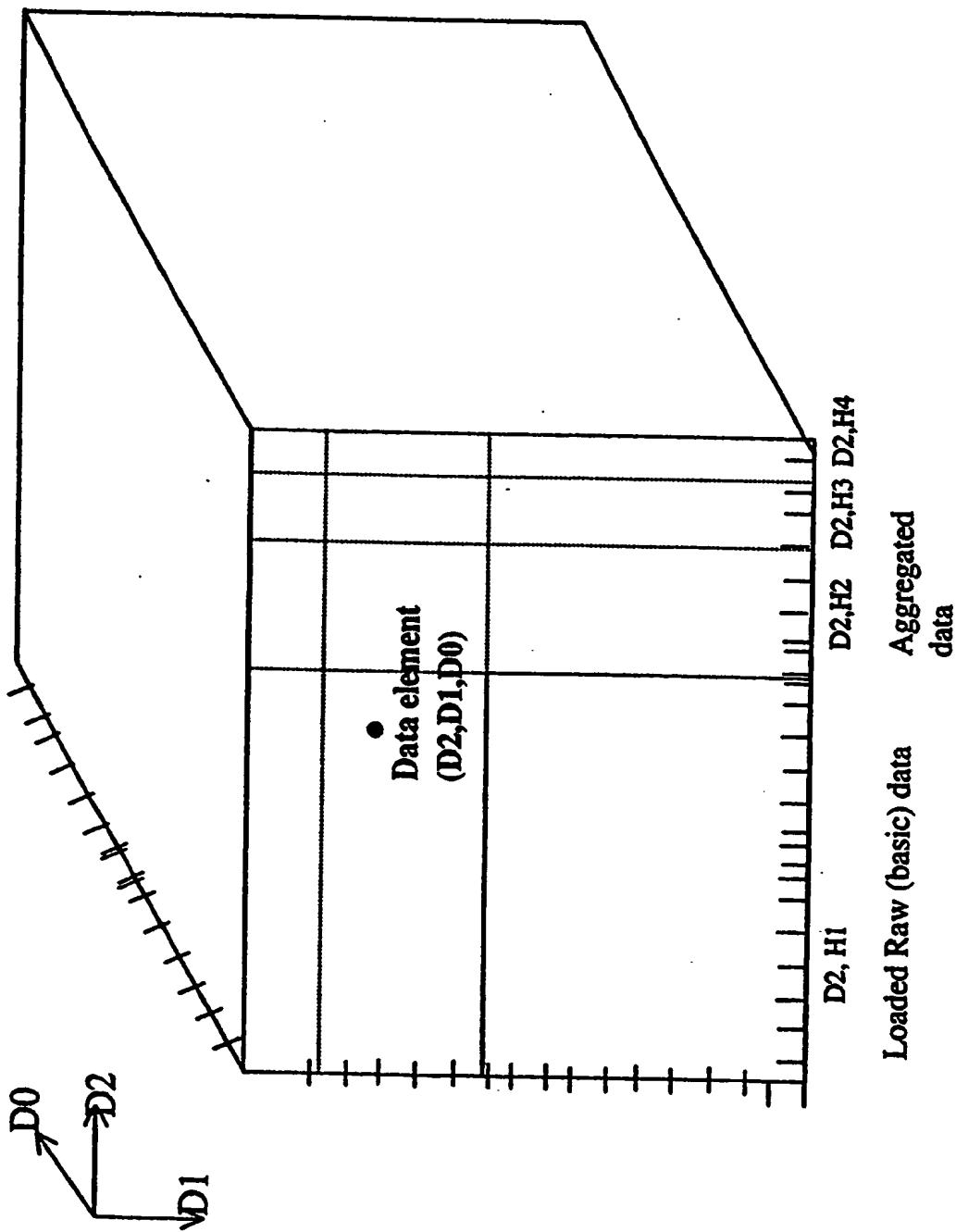
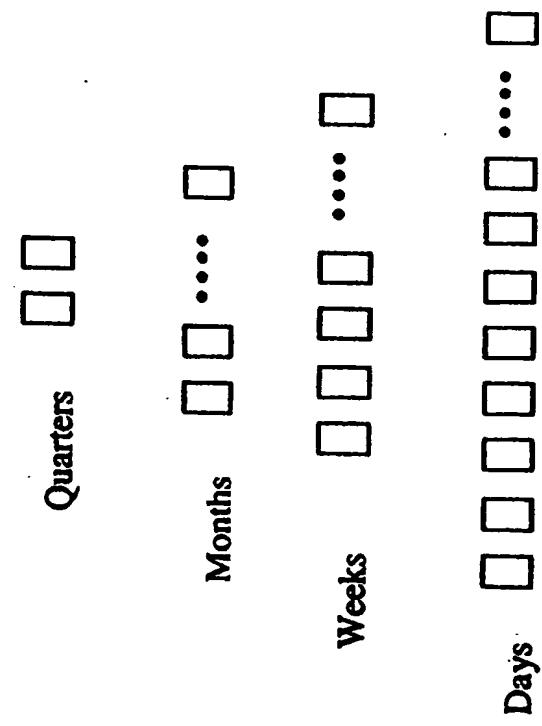


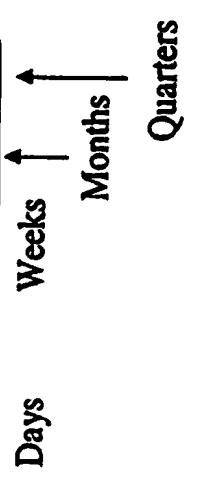
Fig. 3C1  
(PRIOR ART)



$D_0$

$\rightarrow$  TIME ( $D_2$ )

$D_1$



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Spatial occupancy of TIME hierarchy

Fig. 3C2  
(PRIOR ART)

Fig. 3C3  
(PRIOR ART)

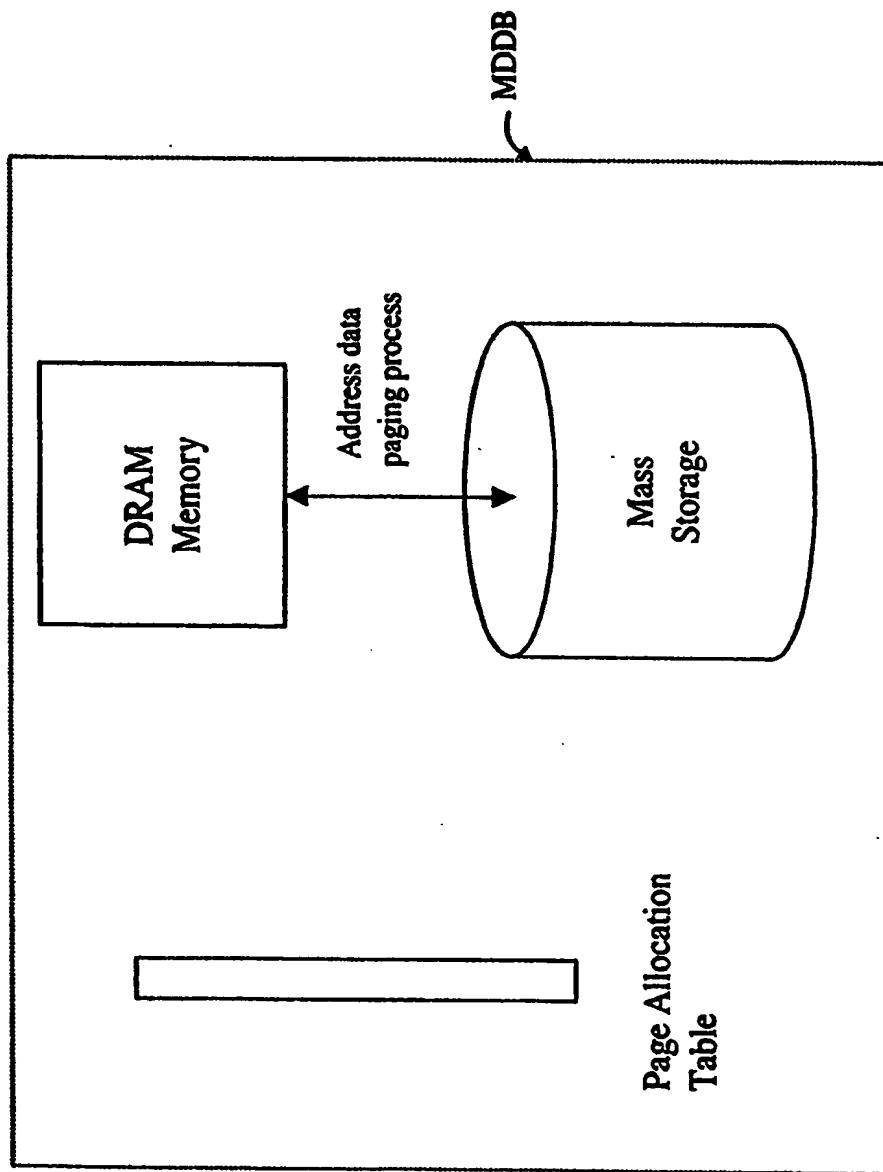


Fig. 4  
(PRIOR ART)

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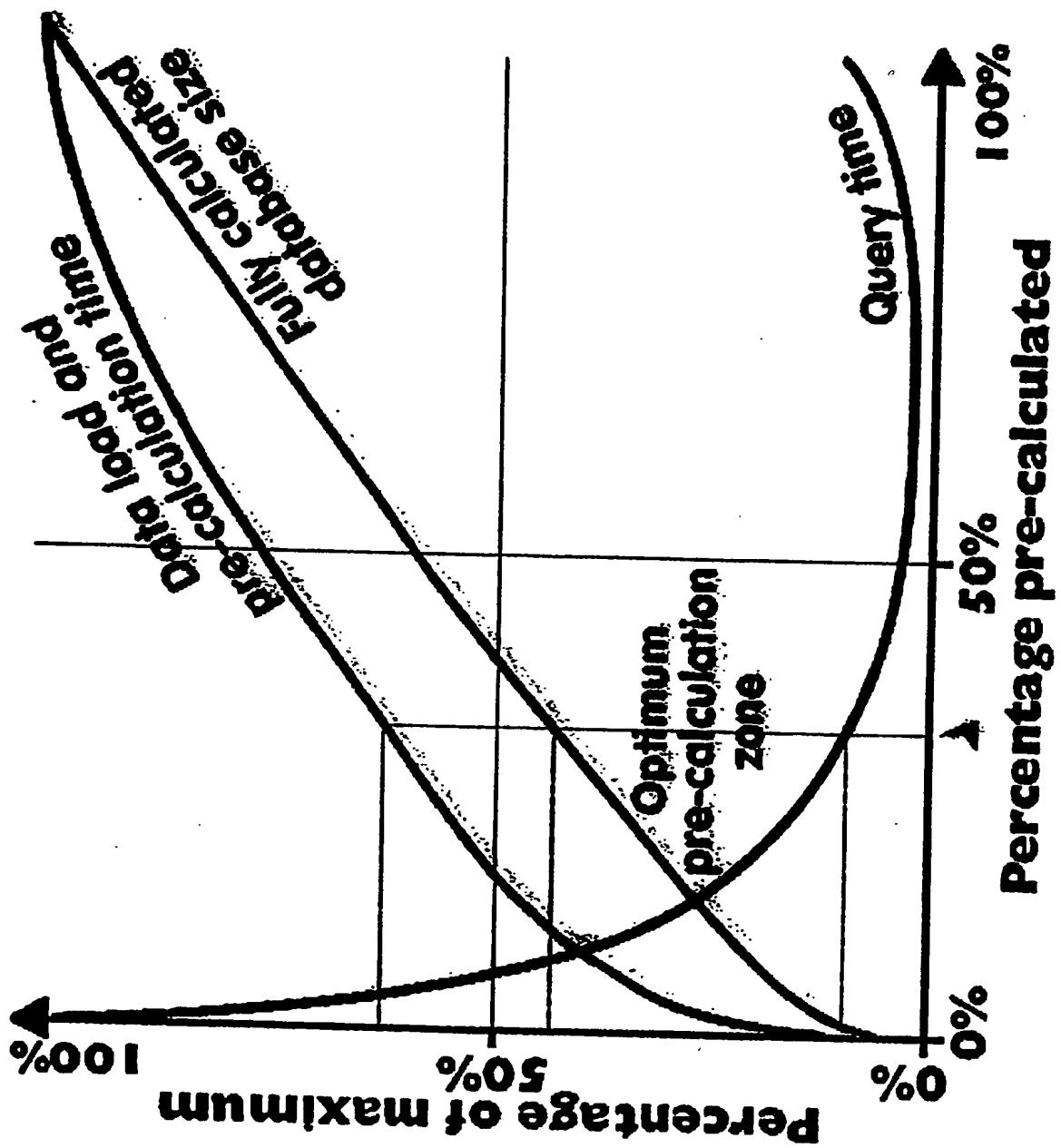


Fig. 5  
(PRIOR ART)

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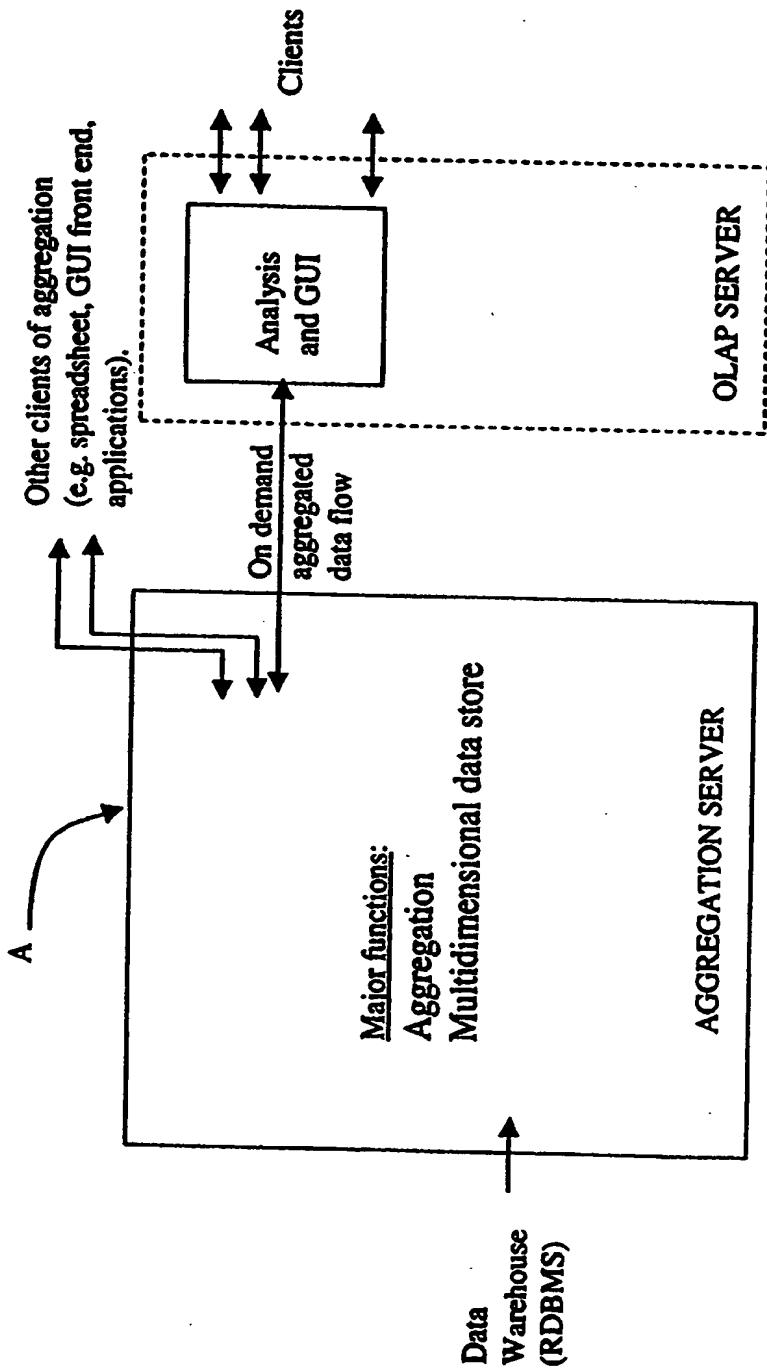


Fig. 6A

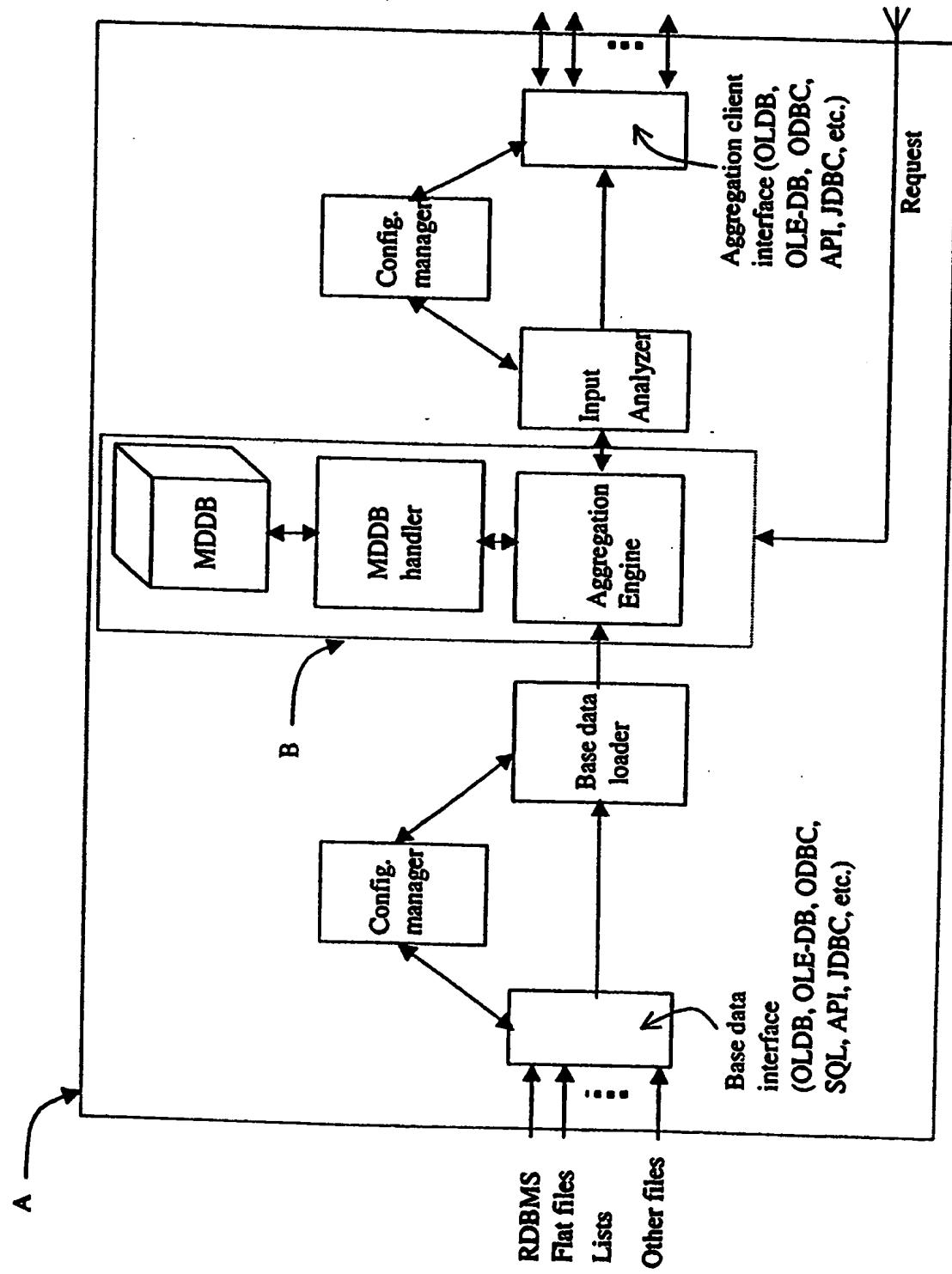


Fig. 6B

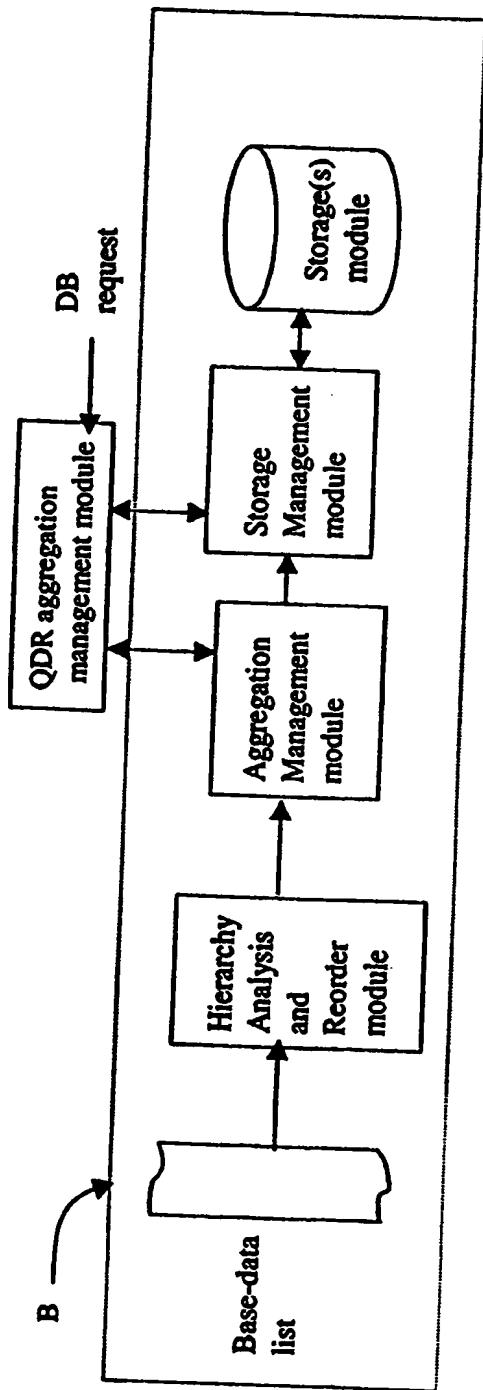


Fig. 6C

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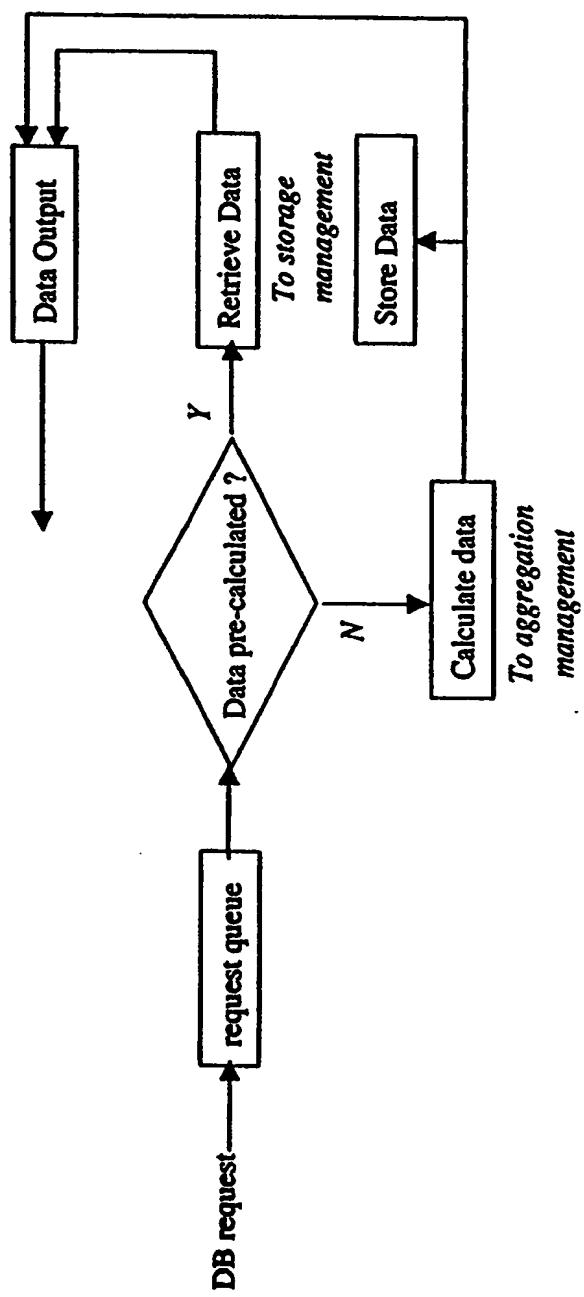


Fig. 6D

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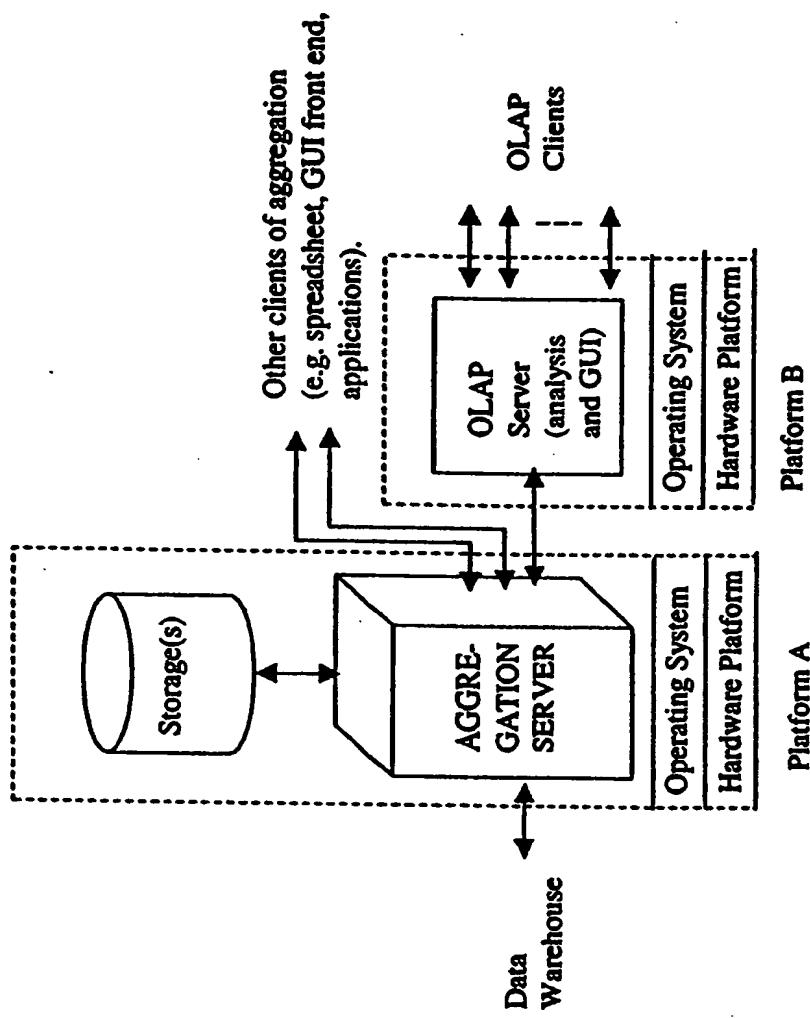


Fig. 7A

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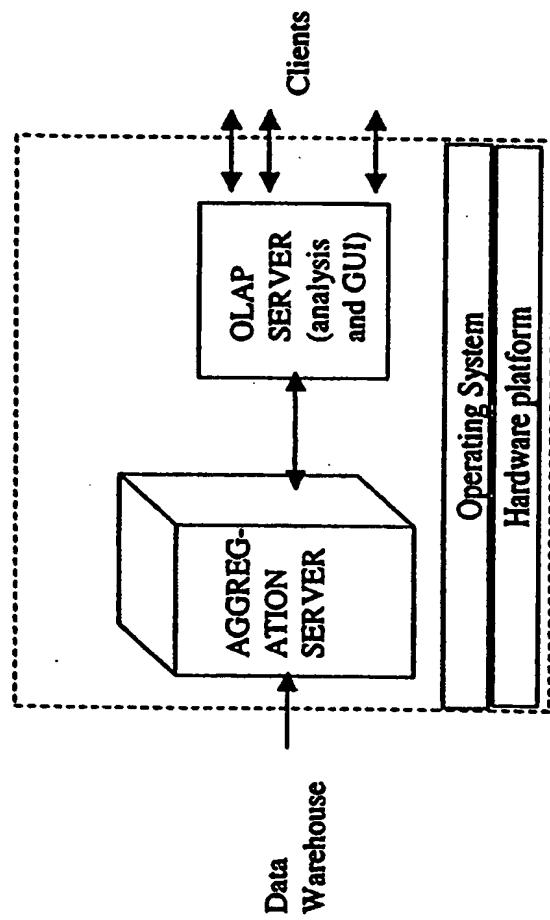


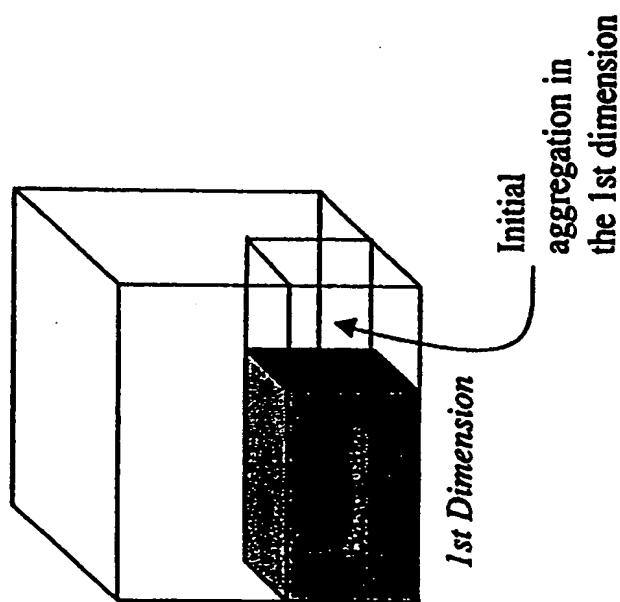
Fig. 7B

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	Nbr of atomic data values	Leaf node density %	Number of values in cube after roll-up	Oracle EXPRESS v. 6.2	Implementation of current invention
D1	6 302 M	9	427 M	16 h	15 m
D2	4 414 M	1.27	989 M	50 m	5 m
D3	5 14,499 M	0.03	63,954 M	31 h	1h 23m
D4	6 623,494 M	8*10 <sup>-7</sup>	7,930 G	Exceeds 48h	2h 20m
D5	6 243,000 G	10 <sup>-6</sup>	1,160,000 G	22 h	4 m
D6	4 7 M	defined as 100	19 M	15 m	1 m

Fig. 8A

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**Fig. 9A**

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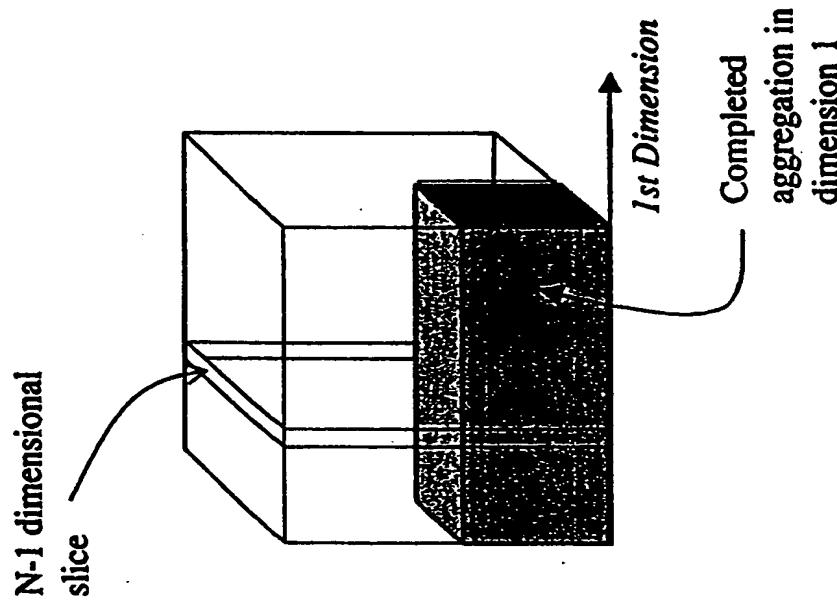
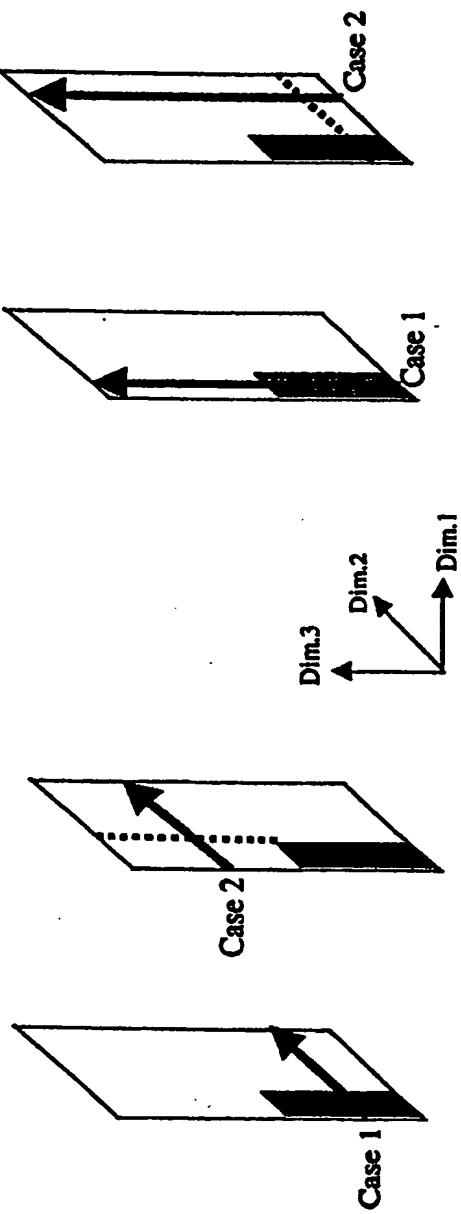


Fig. 9B



a. Directed aggregation  
in dimension 2, cases 1 and 2.  
b. Directed aggregation  
in dimension 3, cases 1 and 2.

**Fig. 9C1**  
**Fig. 9C2**

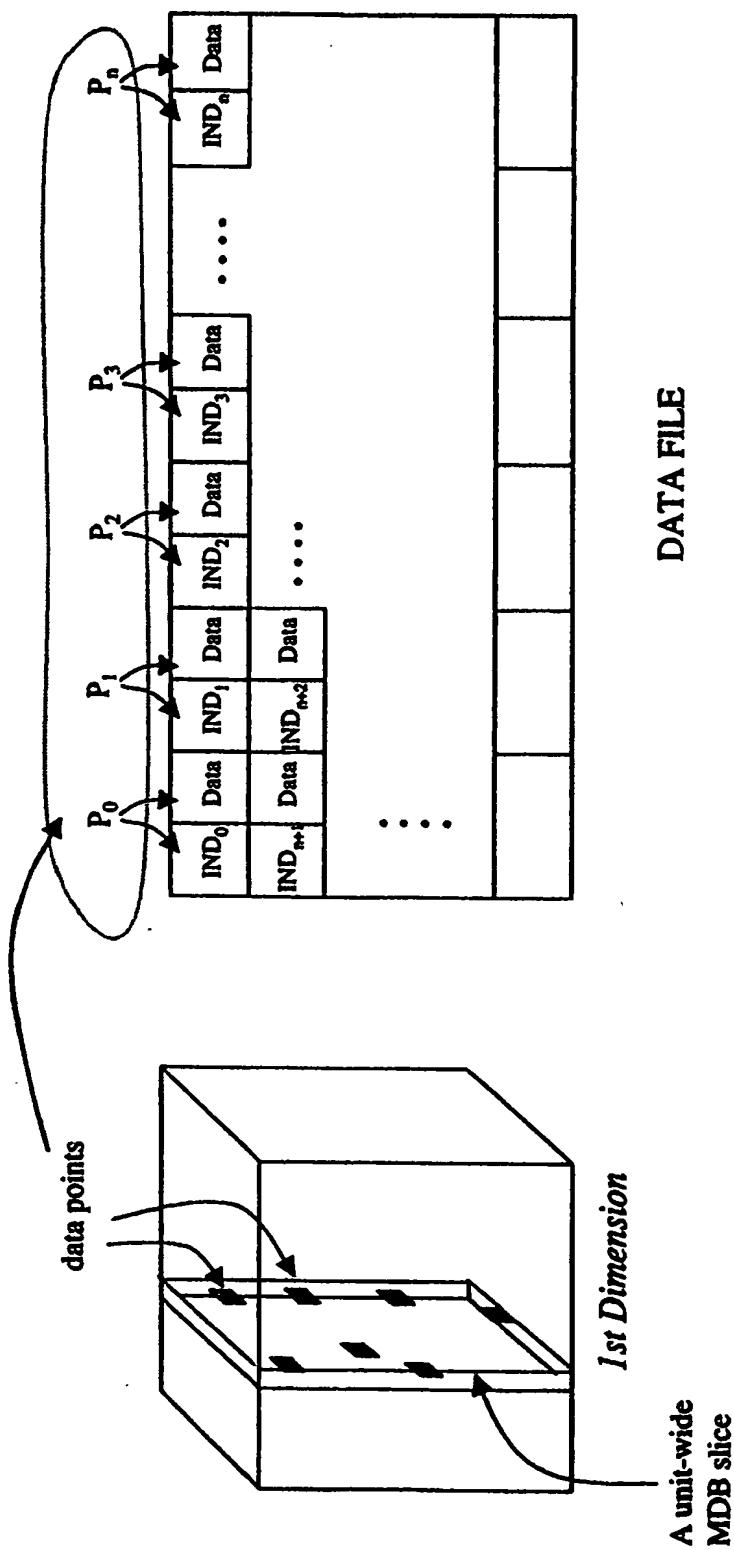


Fig. 10A

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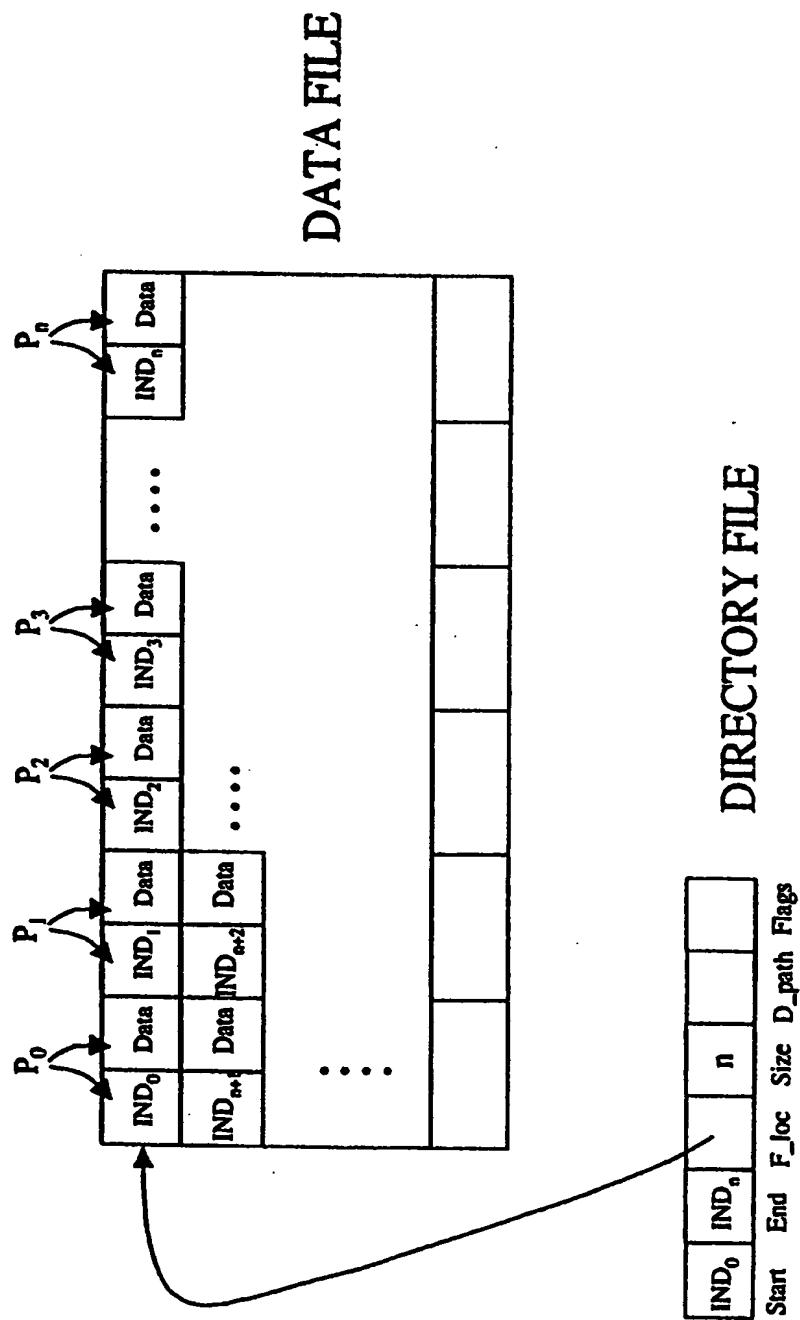


Fig. 10B

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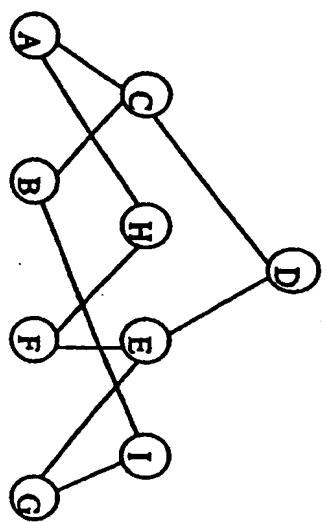
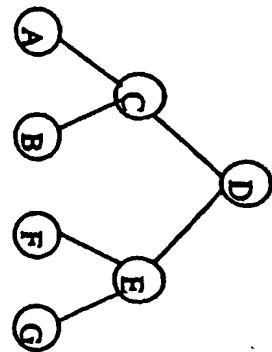
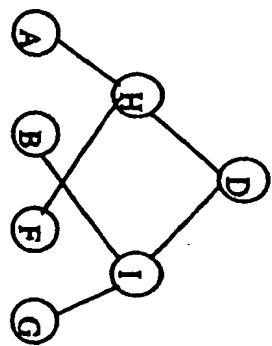


Fig. 11B

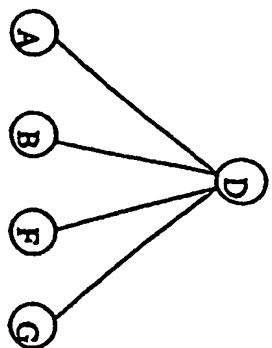
Fig. 11A



Struct. 1



Struct. 2



Struct. 3

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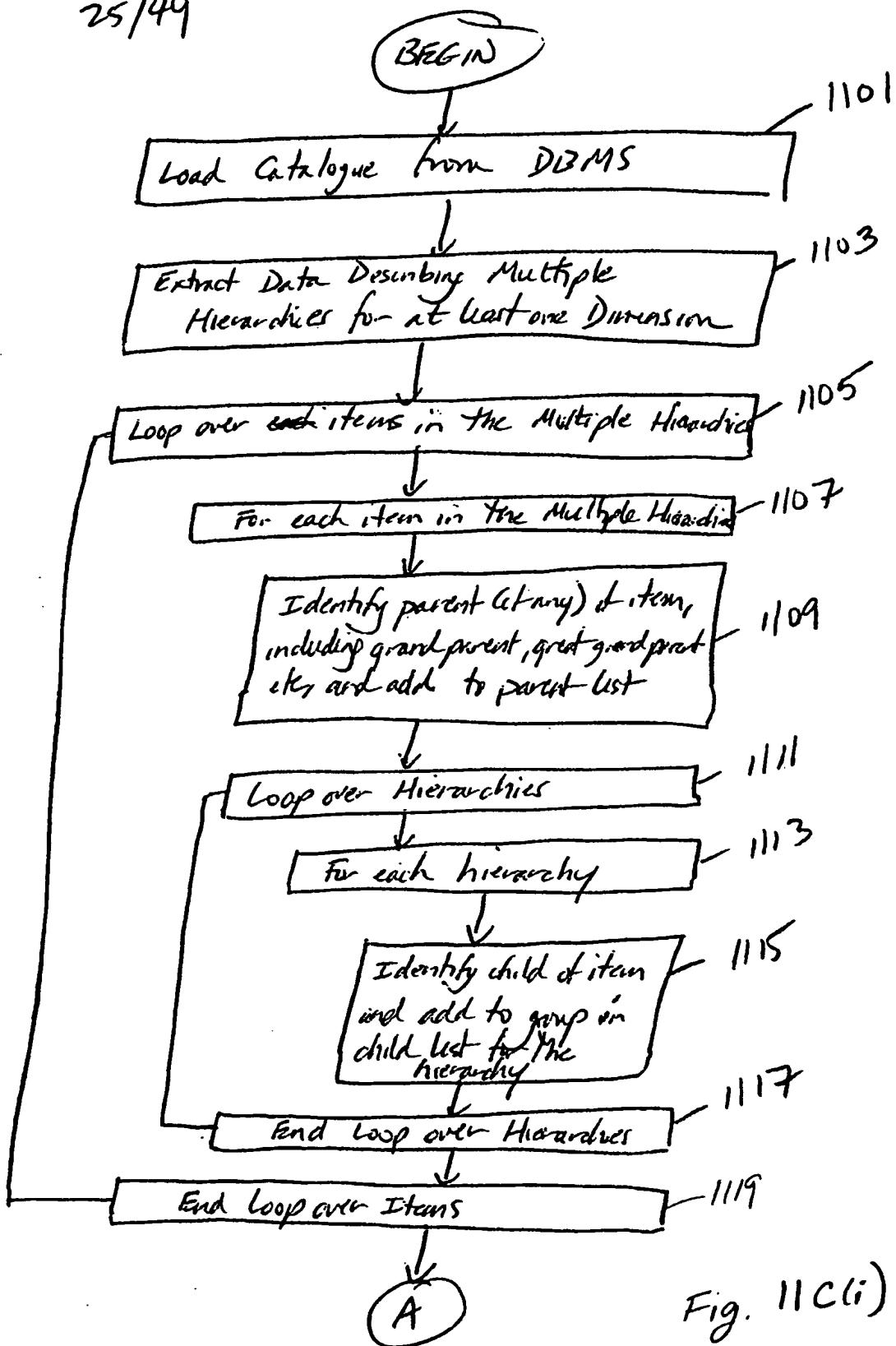
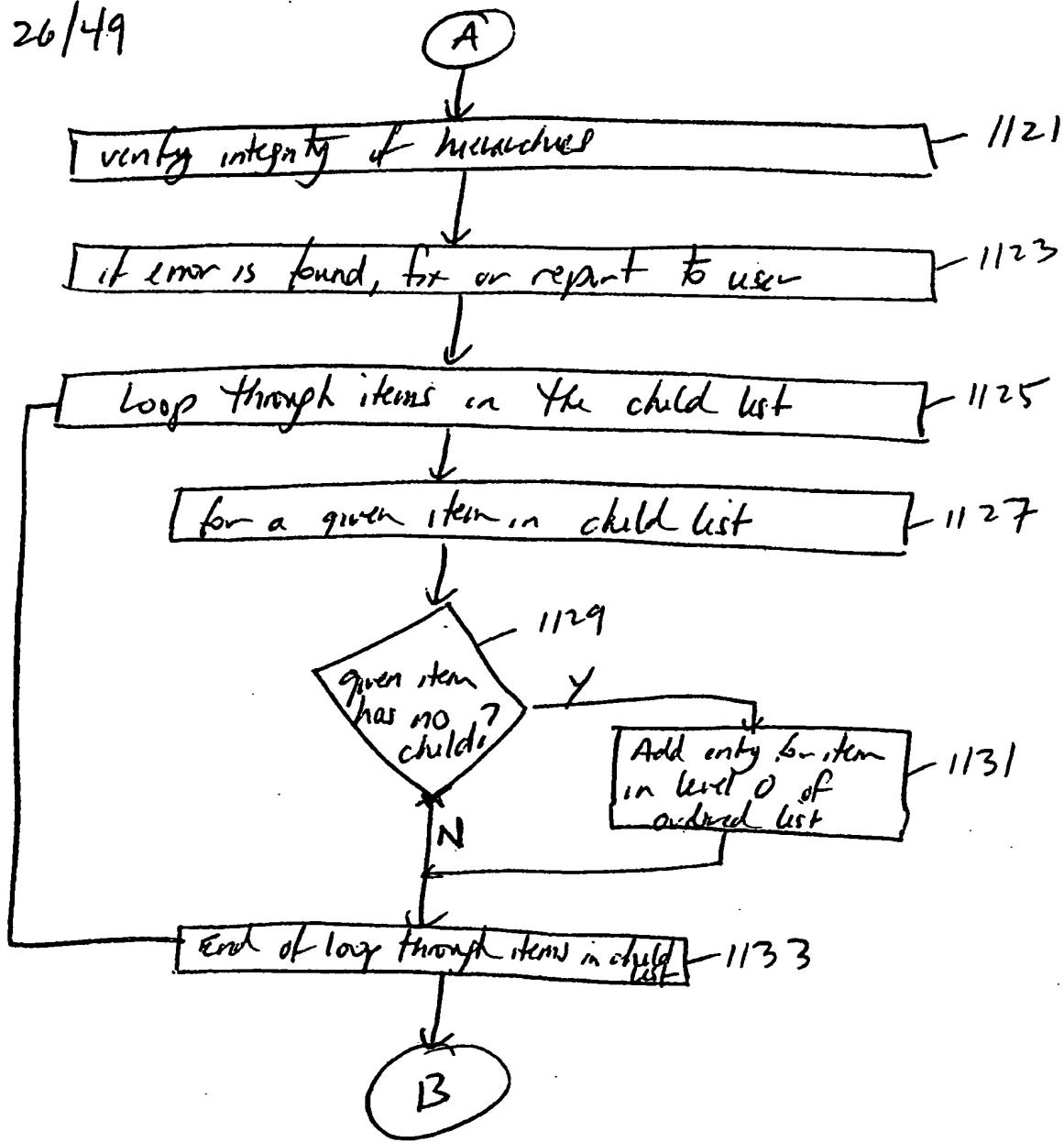


Fig. 11C(i)

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Fg. 11C(ii)

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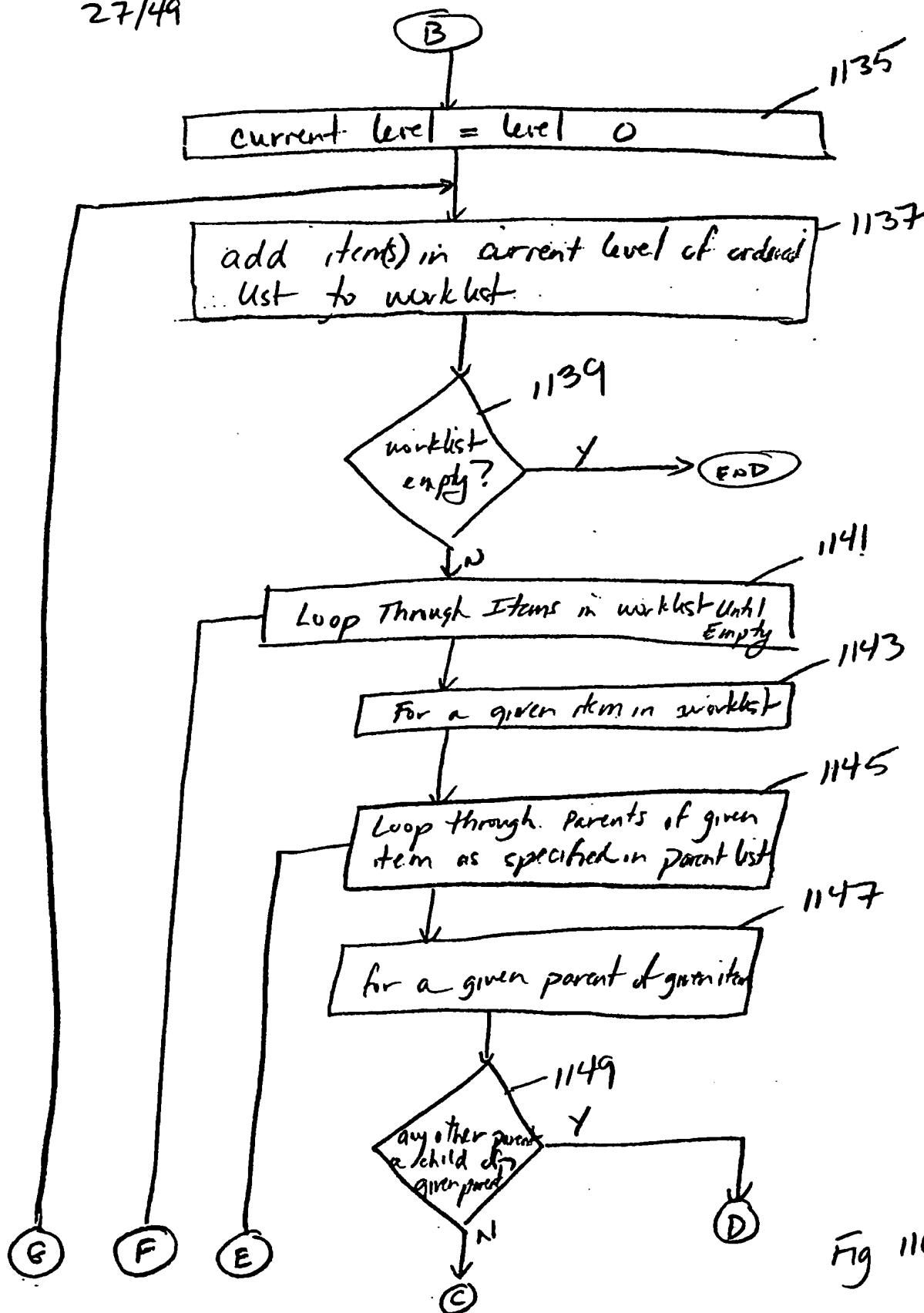


Fig 11C1ii

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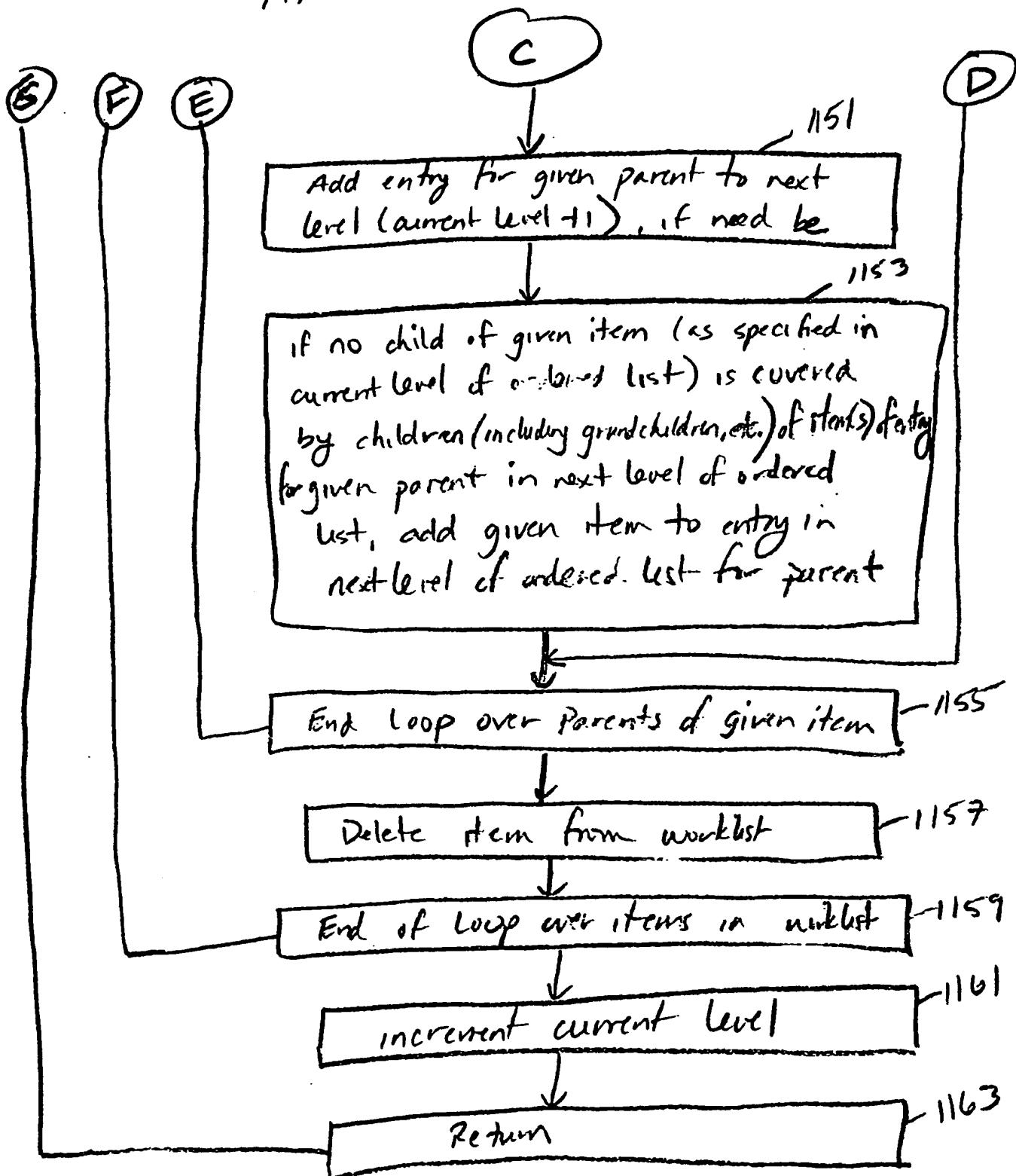


FIG. 11C(iv)

Parent List

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Child List

Item	Parent(s)
A	C, H, D
B	C, I, D
F	E, H, D
G	E, I, D
C	D
H	D
E	D
I	D
D	-

FIG. II C (v)

Ordered List

Level 0	
Item	children
A	-
B	-
F	-
G	-

FIG. II C (vii)

Level 1	
Item	children
C	A, B
H	A, F
I	B, G
E	F, G

FIG. II C (viii)

Item	Child(ren)
A	-
B	-
F	-
G	-
C	$\langle A, B \rangle$
H	$\langle F, G \rangle$
E	$\langle A, F \rangle$
I	$\langle B, G \rangle$
D	$\langle A, B, F, C \rangle, \langle H, I \rangle, \langle C, E \rangle$

Fig. II C (vi)

Level 2	
Item	children
D	C, E

FIG. II C (ix)

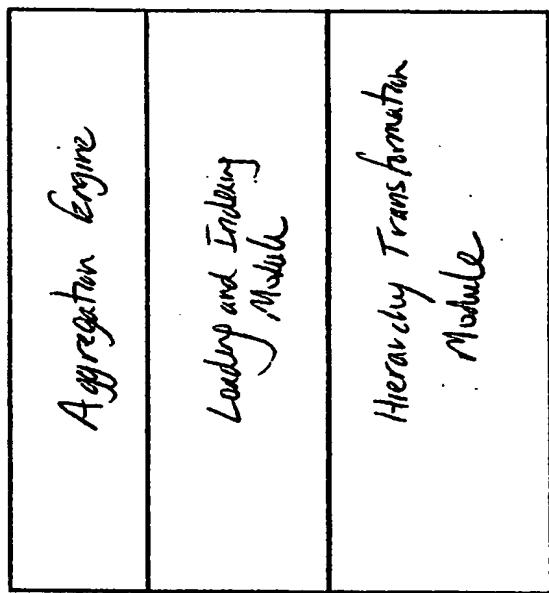


Fig. 12

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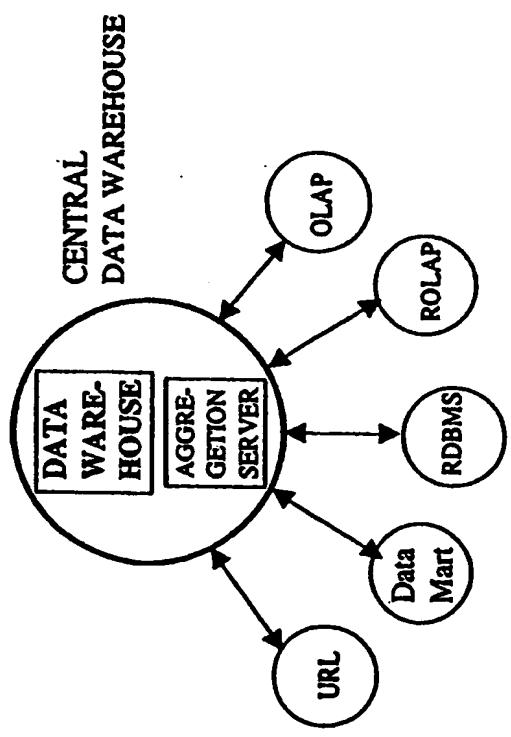
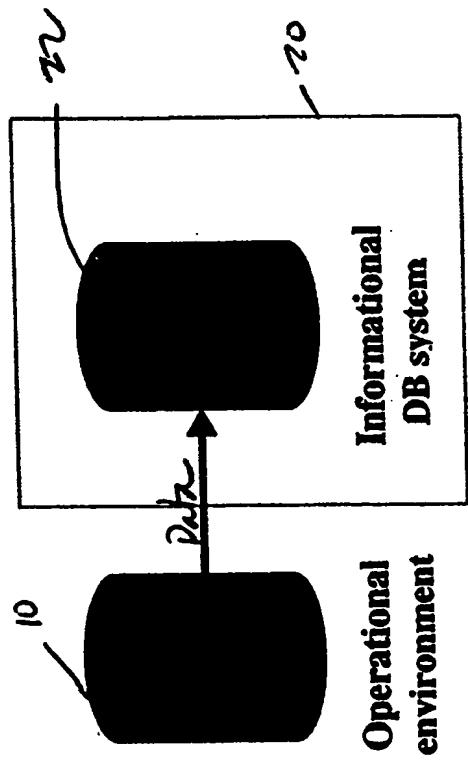


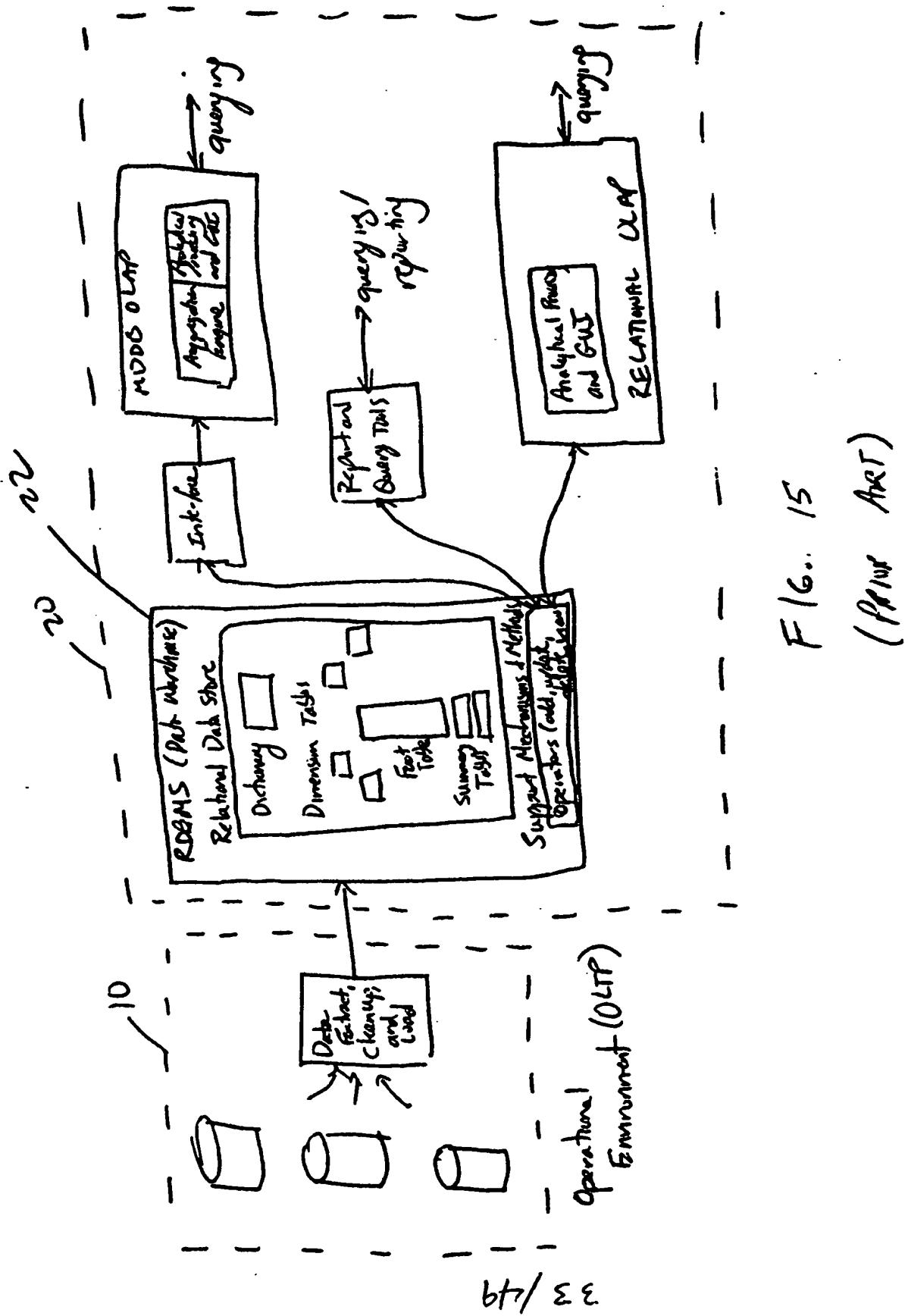
Fig. 13



- |                        |                                  |
|------------------------|----------------------------------|
| Continuous data        | Snap-shots                       |
| On-line processed data | Extract processing (copied data) |
| Normalized data        | Data warehouse                   |
|                        | Data marts                       |
|                        | OLAP                             |
|                        | Data mining                      |
|                        | EC-enabled Web <i>services</i>   |
|                        | EDI B-2-B Exchange               |
|                        | De-normalized data               |

FIG. 14 (17102 APR)

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CELLAR	Wine	Year	Bottles
	Chardonnay	1996	4
	Fume Blanc	1996	2
	Pinot Noir	1993	3
	Zinfandel	1994	9

FIG. 16A

Result:	Wine	Year	Bottles
	Chardonnay	1996	4
	Fume Blanc	1996	2

FIG. 16B

Result:	Wine	Year	Bottles
	Chardonnay	1996	4
	Fume Blanc	1996	2
	Pinot Noir	1993	3
	Zinfandel	1994	9

FIG. 16C

Project operator:  
 SELECT WINE, YEAR, BOTTLES  
 FROM CELLAR;  
 WHERE YEAR > 1995;

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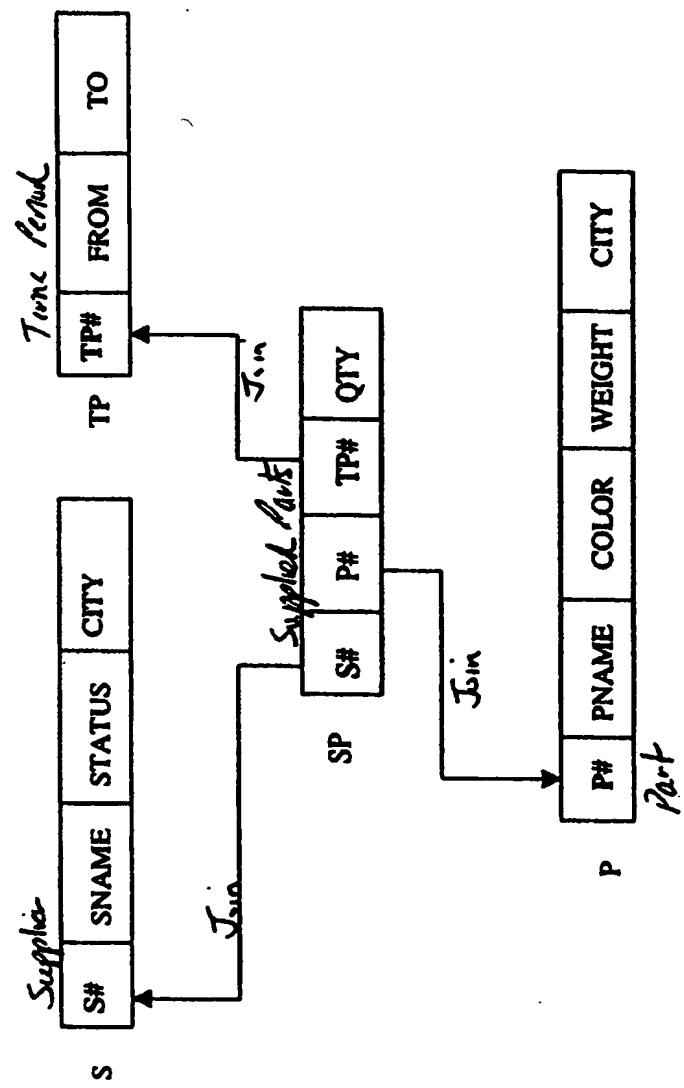


FIG. 17A

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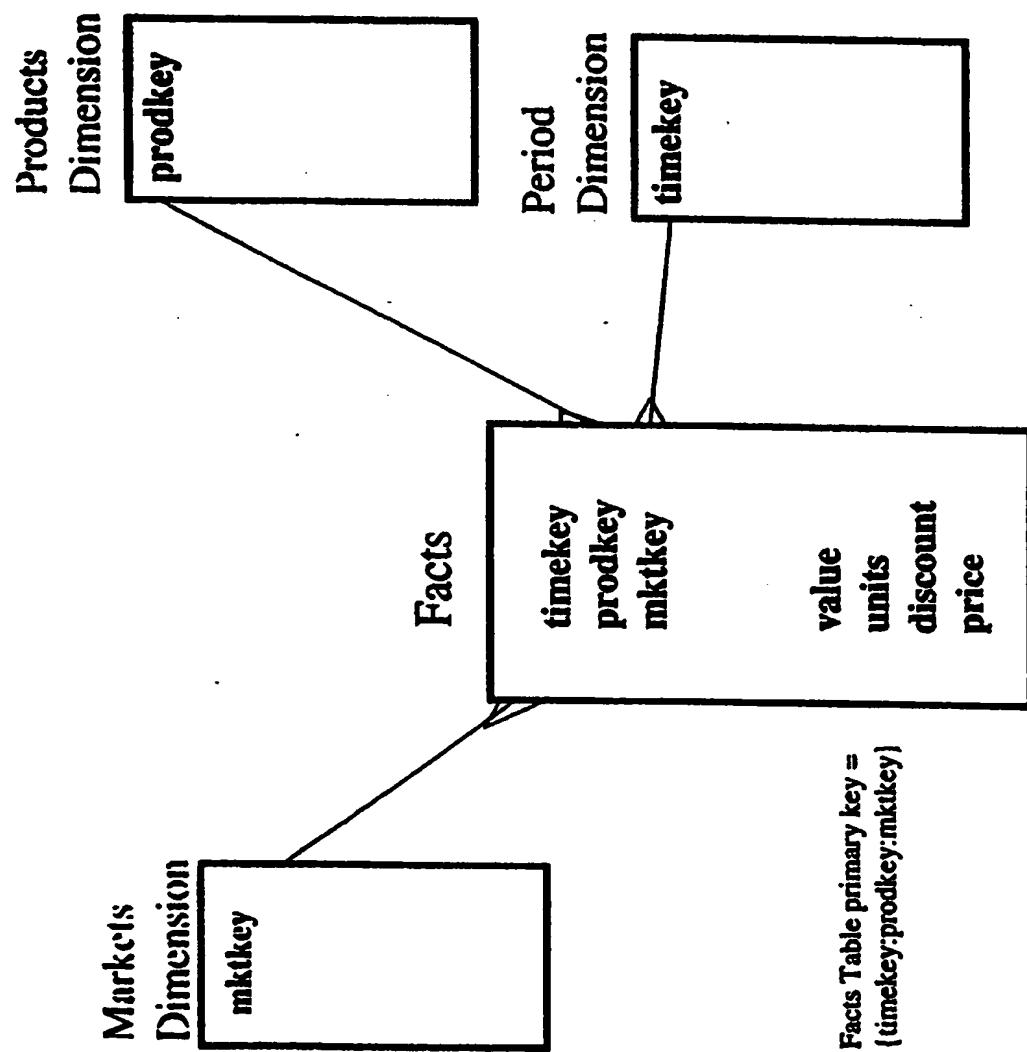
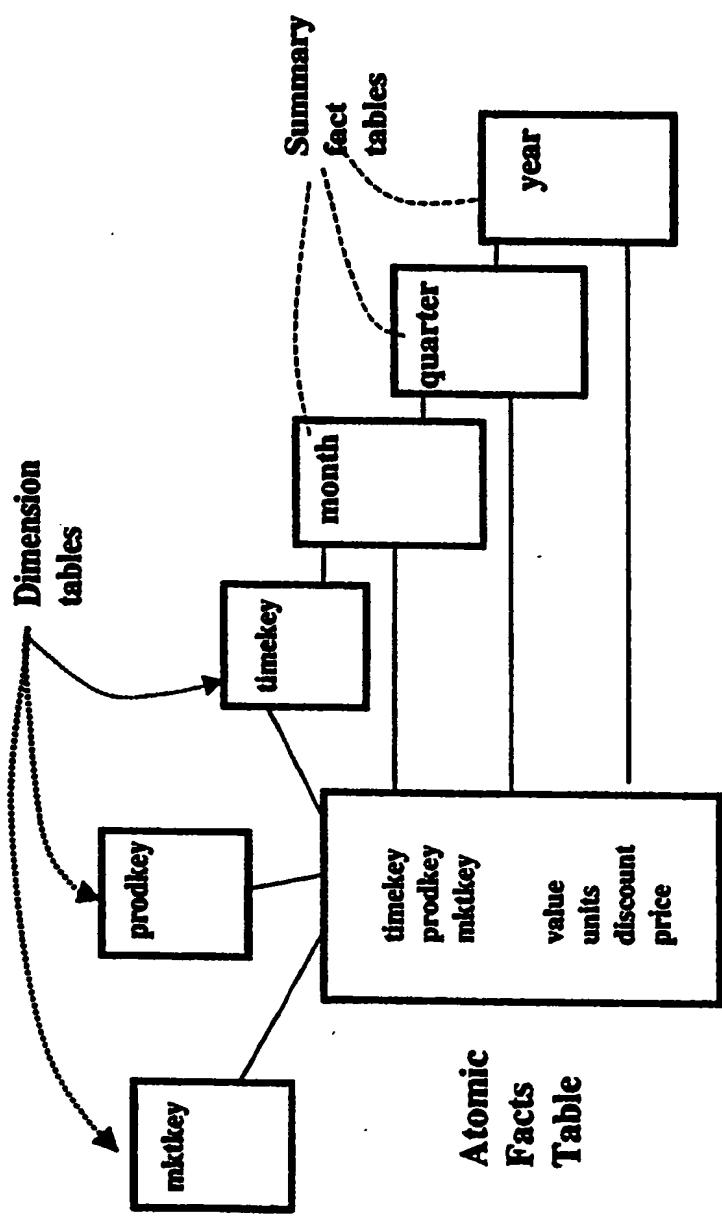


FIG. 184

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F16. 1813

bh/tε

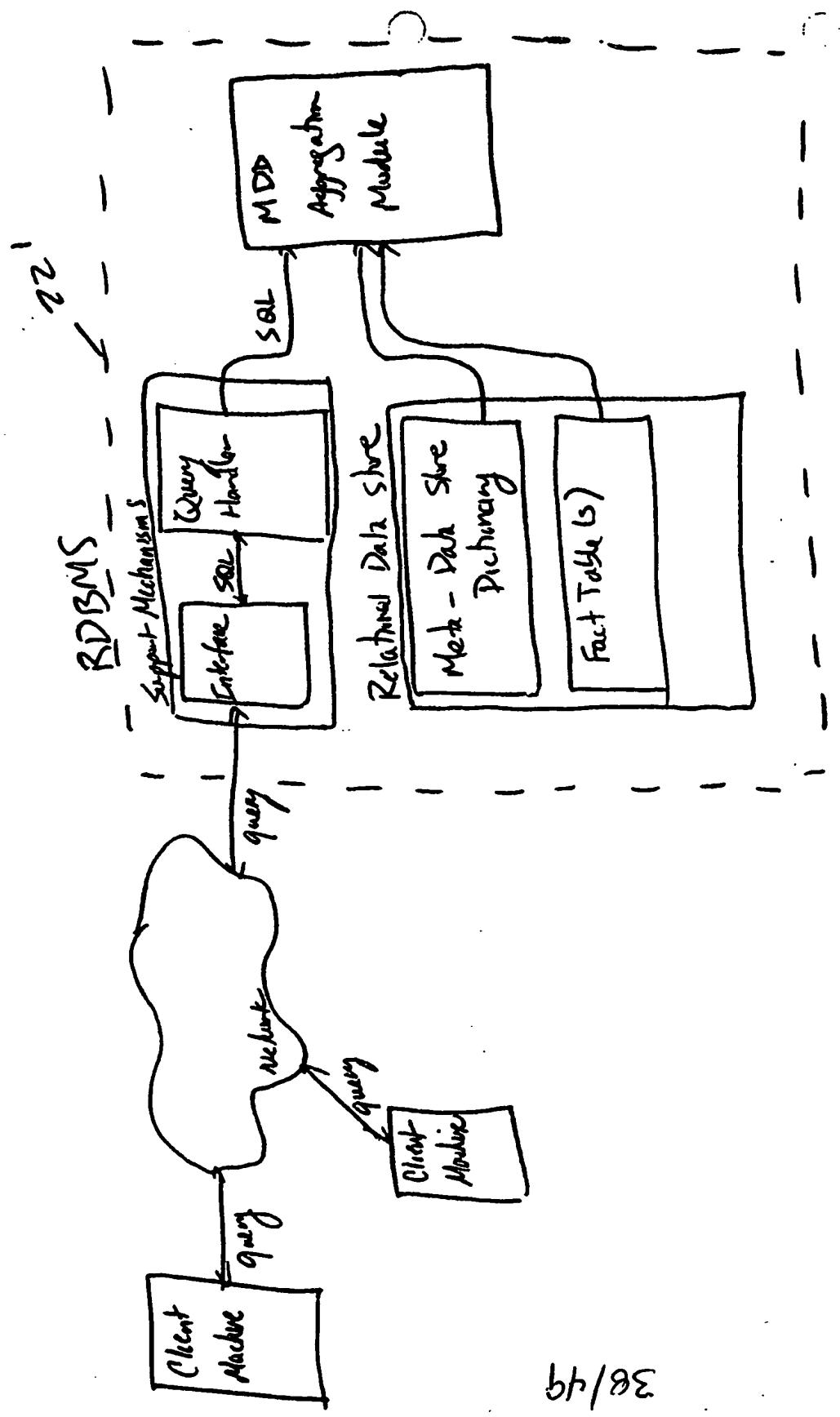
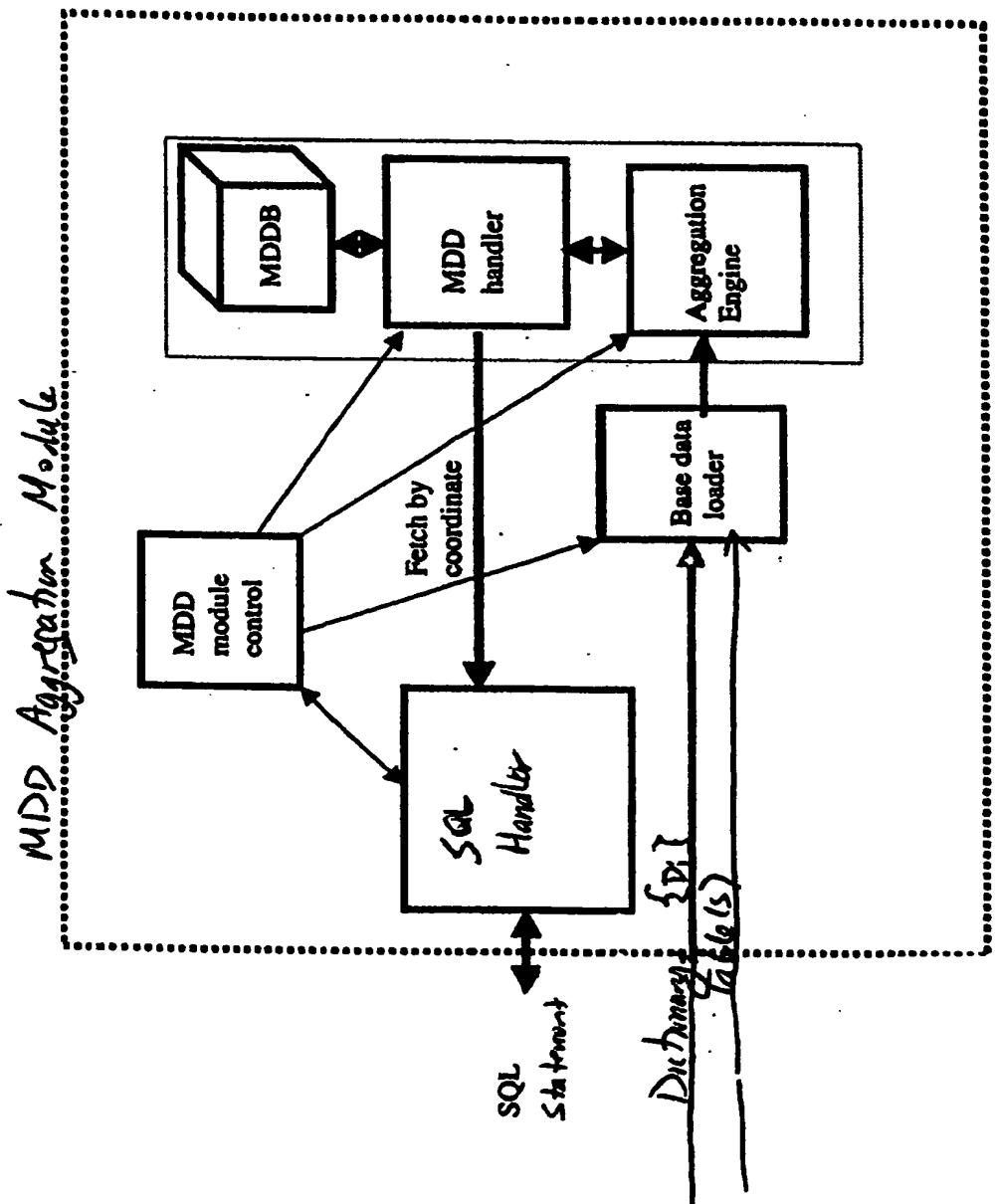


FIG. 19A

FIG. 10B



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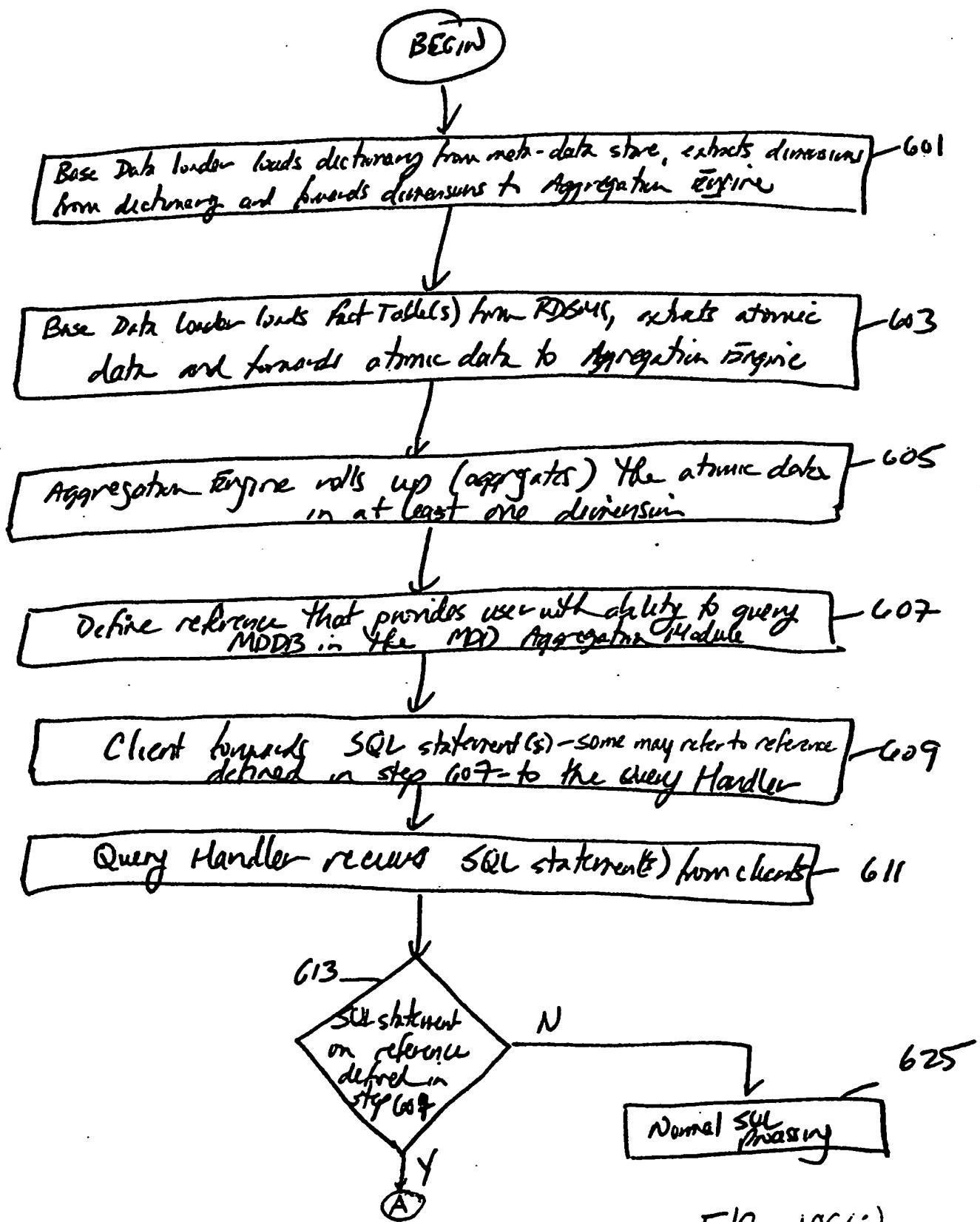


FIG. 19C(i)

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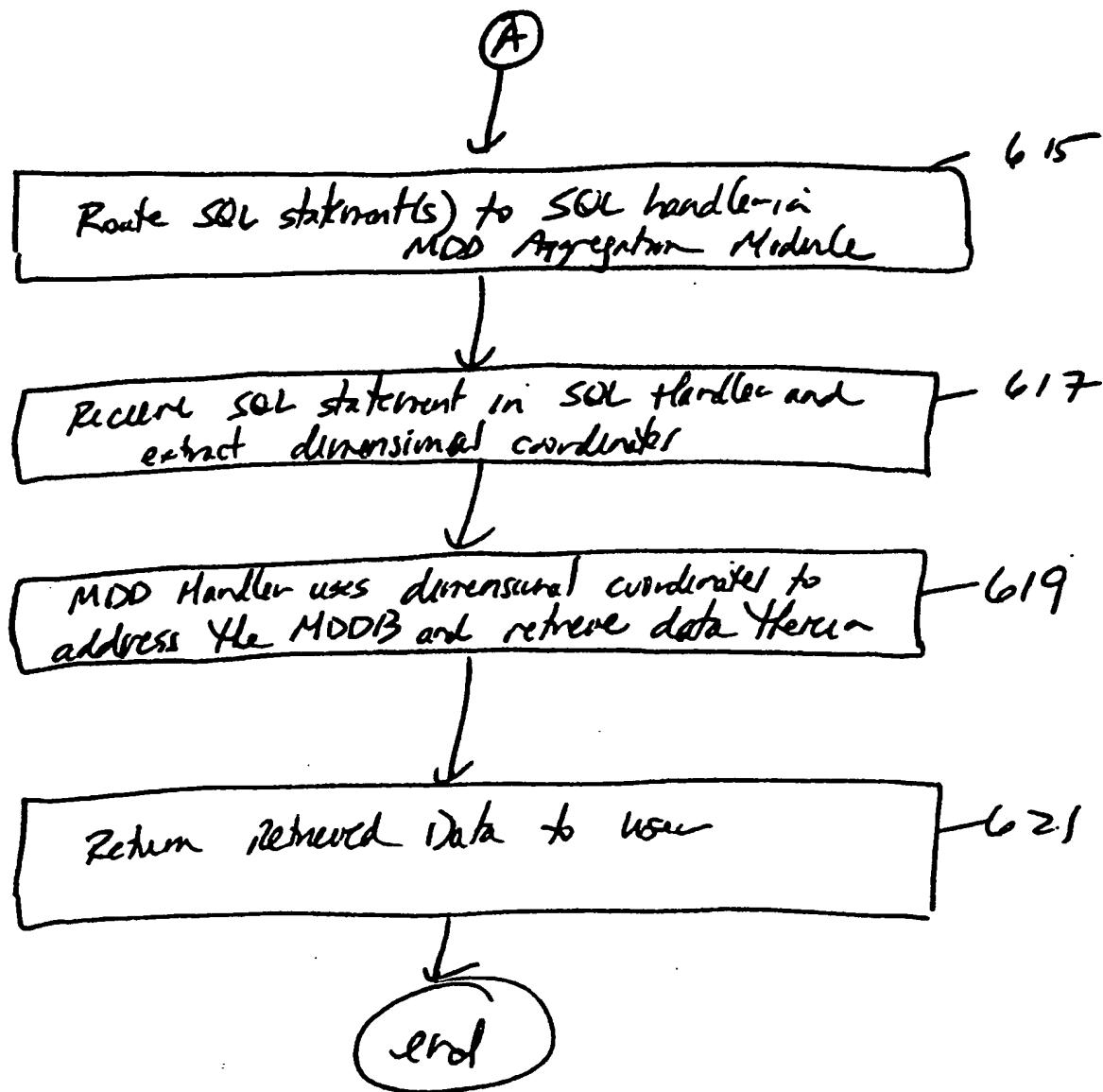


FIG. 19C(ii)

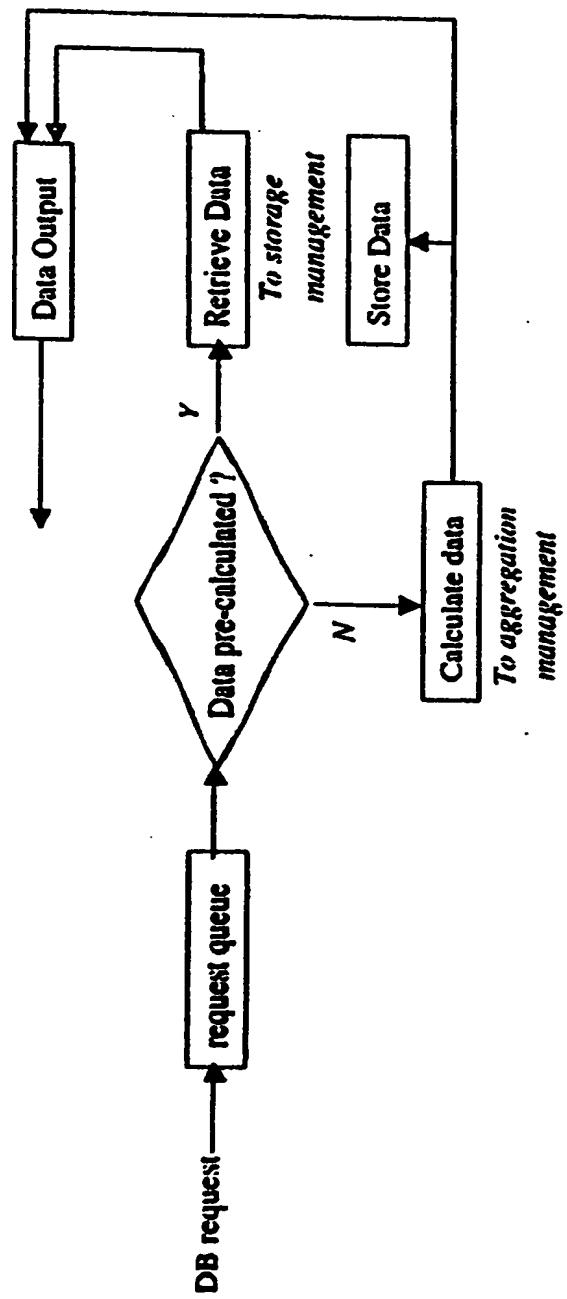


Fig. 1(a)D

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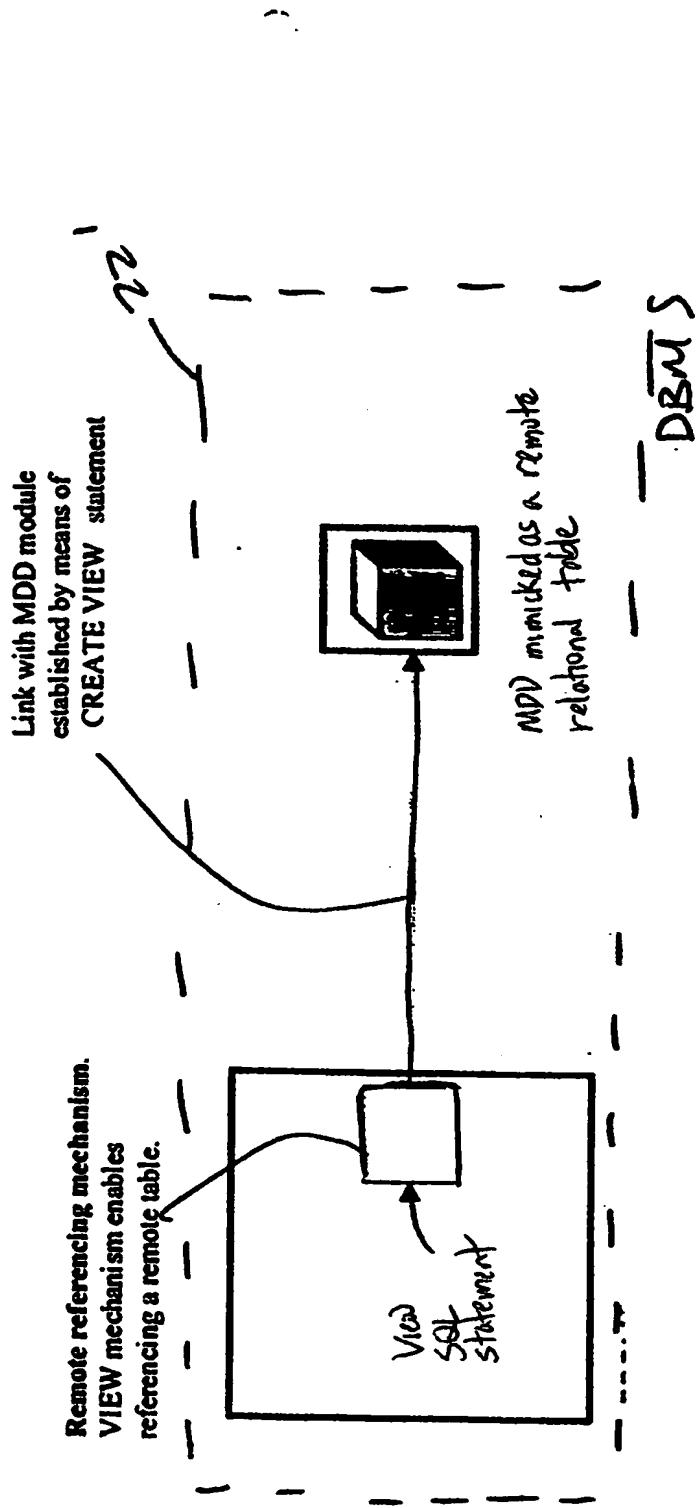


FIG. 19E

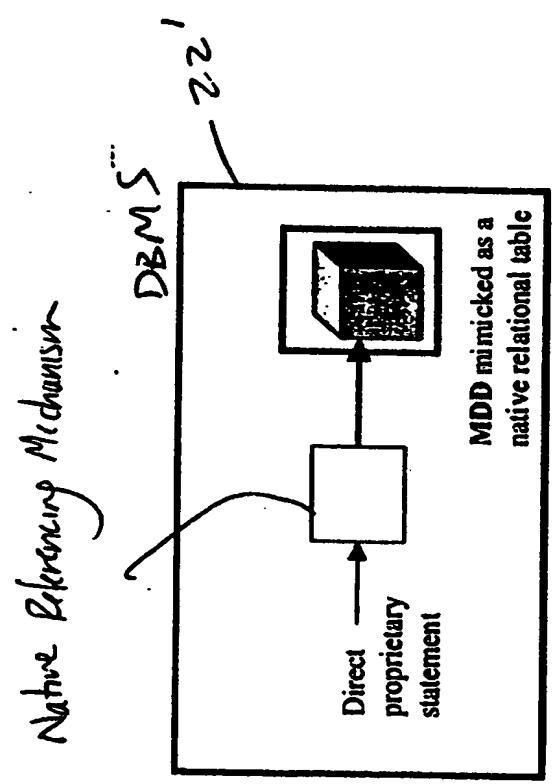
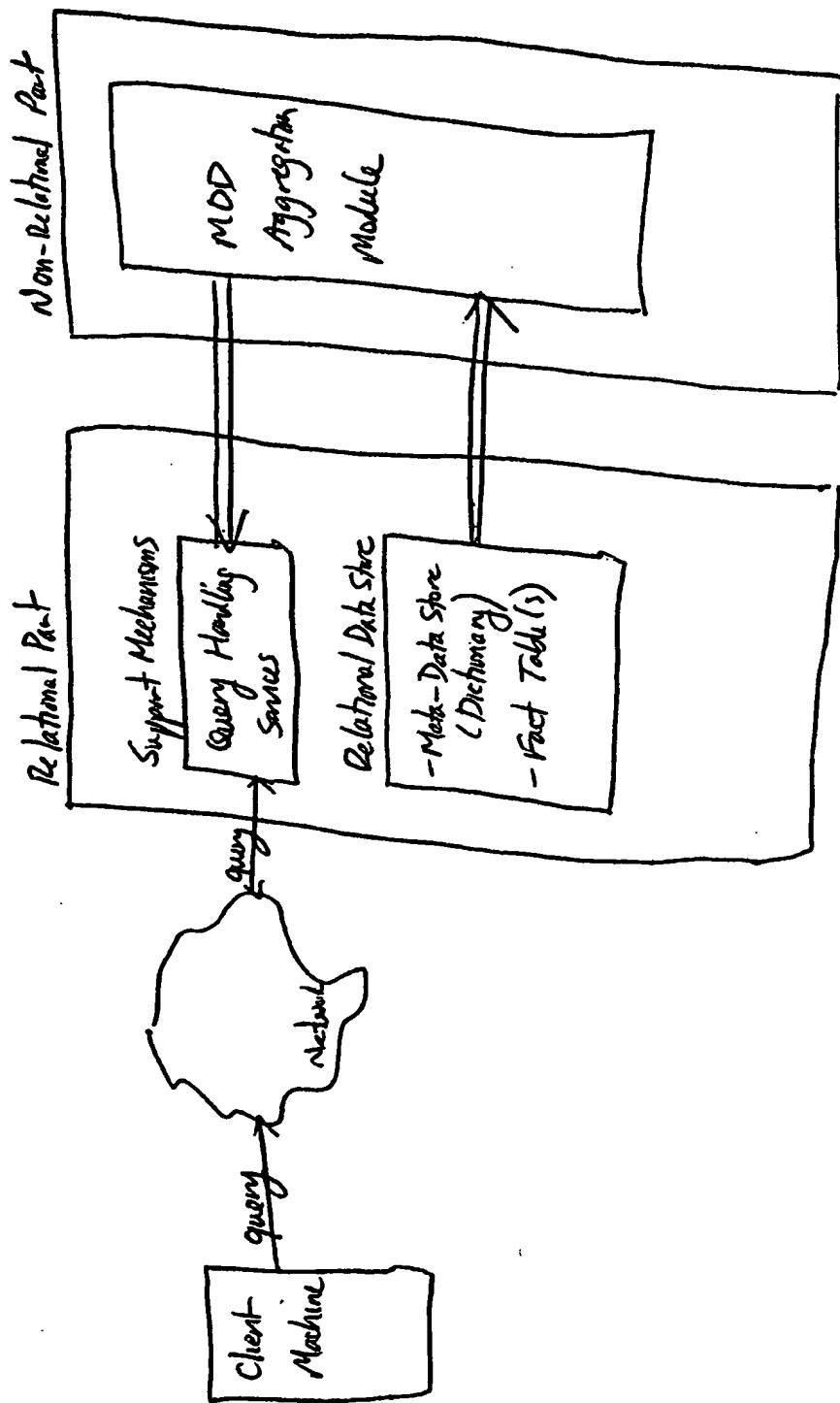


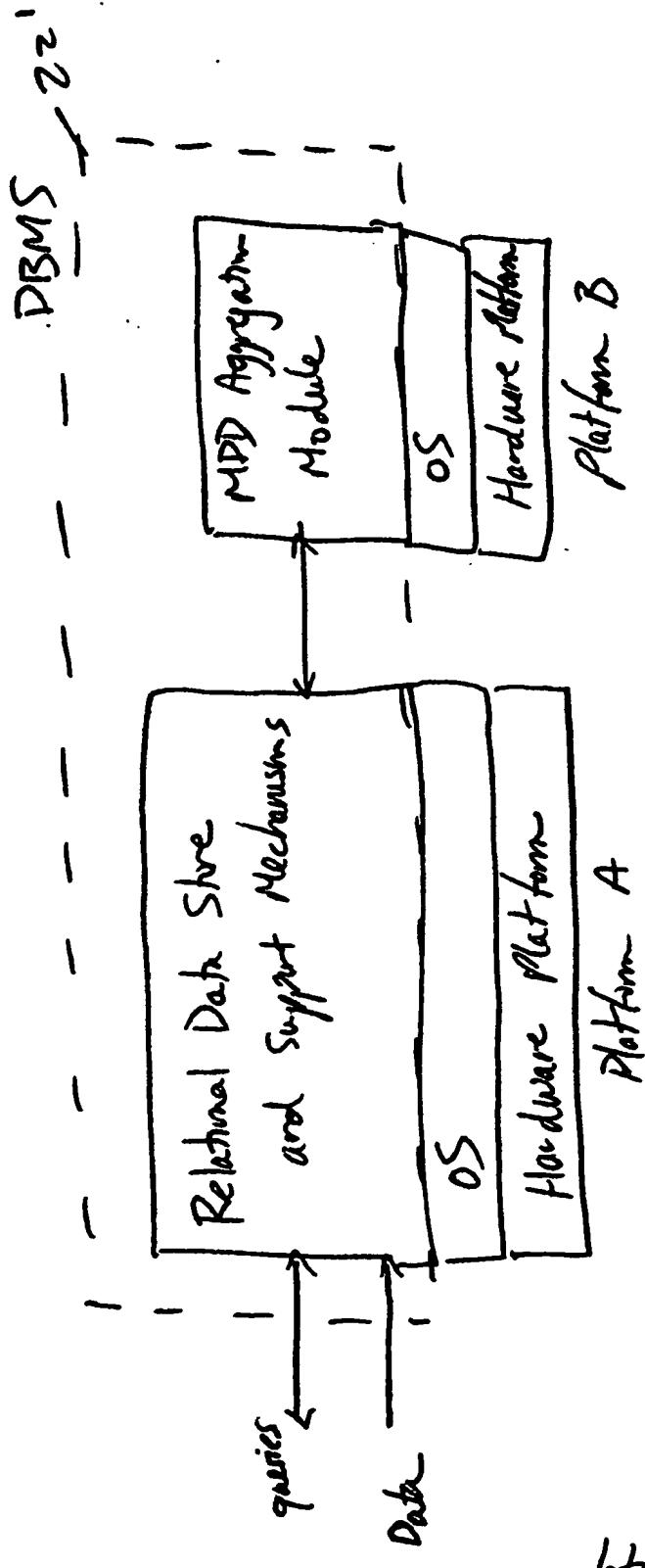
FIG. 1aF

bh/bh

Fig. 19G



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FIG. 204

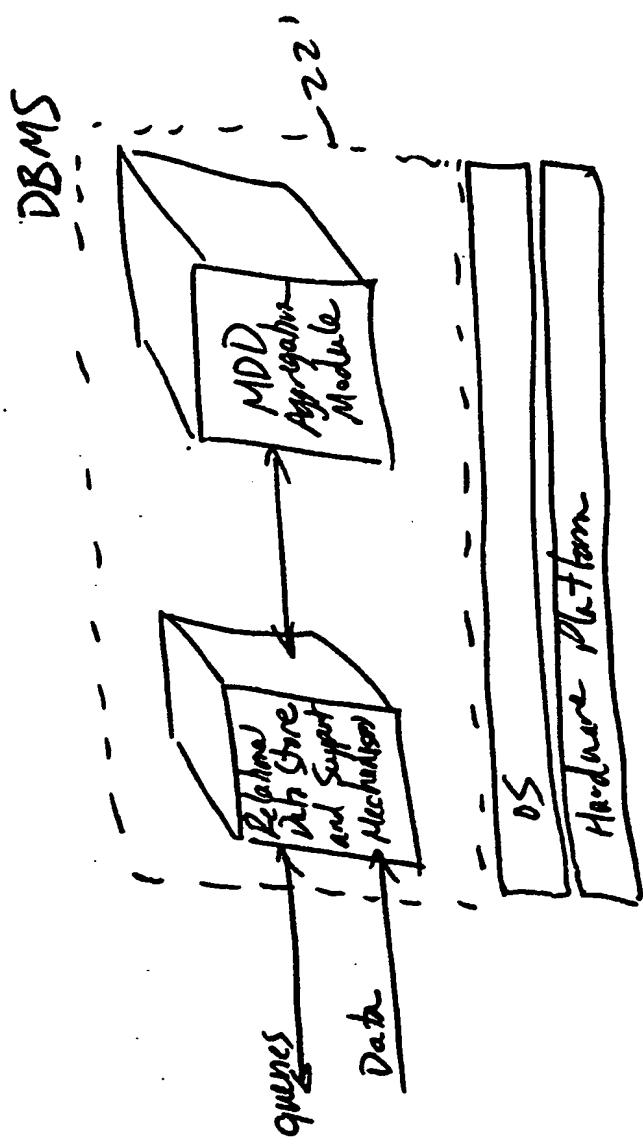


FIG. 20B

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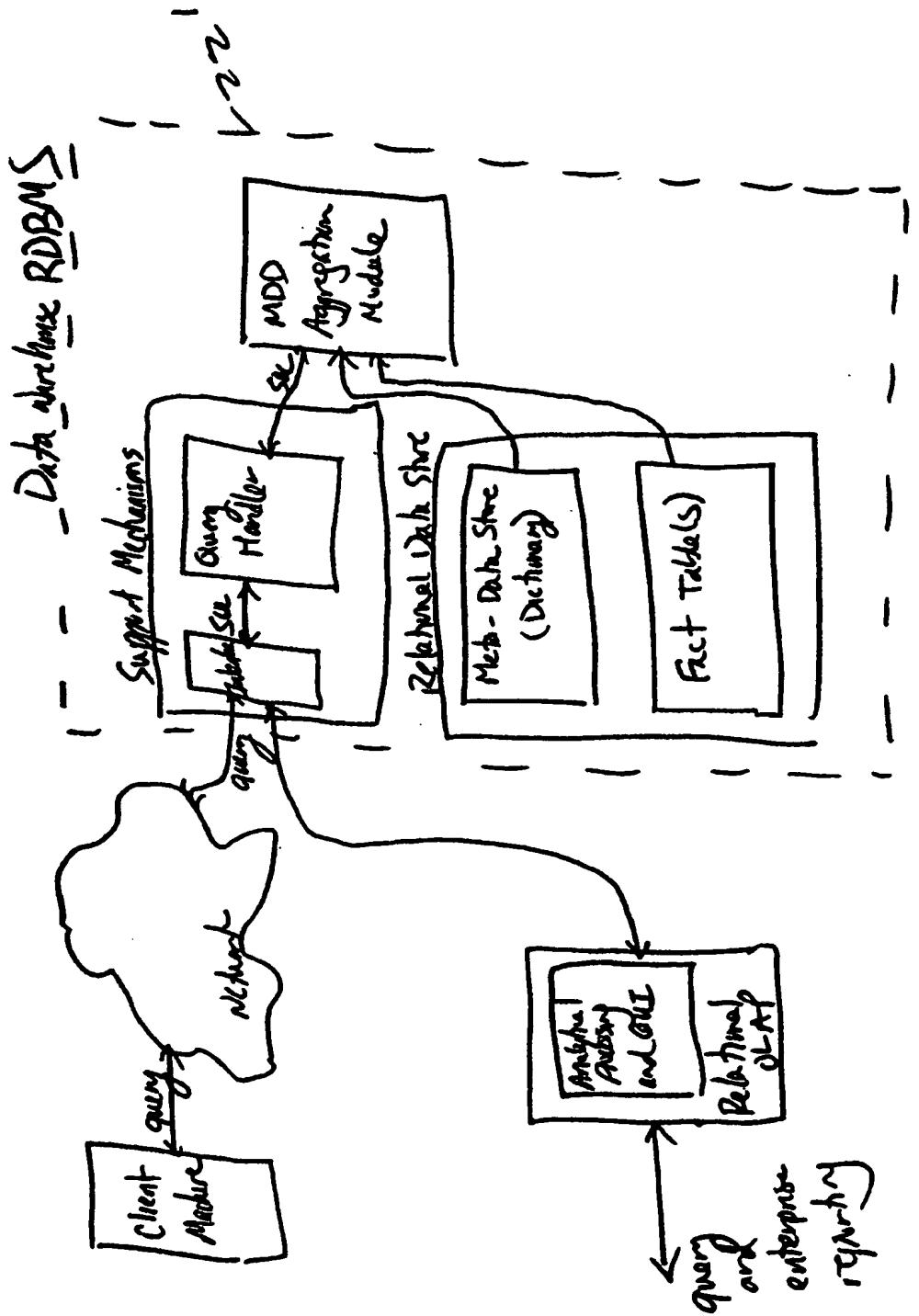


FIG. 21

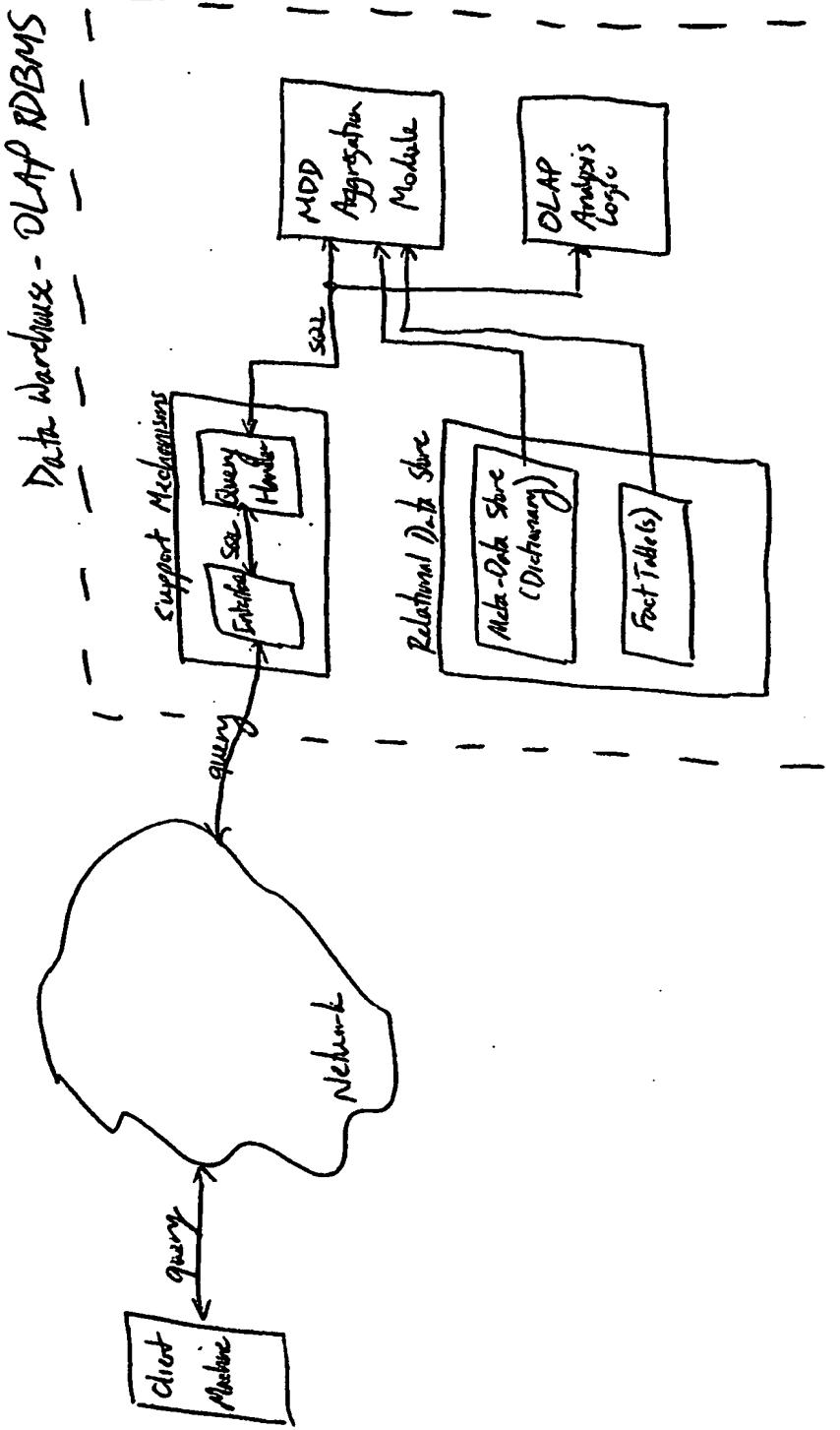


FIG. 22

bt / bt